With METALLURGICAL SUPPLEMENT.

The Engineer.

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PUBLIC NOTICES

Civil Service Commission.

FORTHCOMING EXAMINATION.

ASSISTANT EXAMINERS in the Patent Office (20-25, with extension in certain cases).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 4th June, 1931. 6418

Leicester College of Technology.

Principal: L. W. KERSHAW, B.Sc., A.M. Inst. C.E., F.G.S.

APPOINTMENT OF HEAD OF ENGINEERING DEPARTMENT.

APPLICATIONS are INVITED for the POST of HEAD of the ENGINEERING DEPARTMENT.

Candidates should be Graduates in Engineering and should have had works teaching and organising experience.

Salary £600.

Particulars of duties may be obtained from the Registrar of the College, from whom application forms can be obtained. The forms should be completed and returned not later than February 21st, 1931.

F. P. ARMITAGE,
6385 Director of Education.

Middlesex Education Committee.

ACTON TECHNICAL COLLEGE,
HIGH-STREET, ACTON, W. 3.

APPLICATIONS are INVITED for the APPOINTMENT of PRINCIPAL of ACTON TECHNICAL COLLEGE, to commence duty on 1st May, 1931. The College was opened in September, 1928, in new buildings, which will shortly be enlarged. The number of students on roll is 1750. The Departments of the College for which the Principal will be generally responsible, in addition to the supervision of all other evening classes (roll 750), provided by the Middlesex Education Committee in the Borough of Acton, include:—

Junior Technical School (Engineering).
Part-time Day Classes.
Evening Continuation Classes.

Approved part-time courses are conducted at the College for Advanced National Certificates in Engineering (Mechanical and Electrical), and in Building and Chemistry (Ordinary Grade).

It is desirable that candidates should possess industrial experience in addition to satisfactory academic and professional qualifications, and should give evidence of ability to work in close co-operation with employers in industry.

Salary £750 £25-£1000. The appointment will be subject to satisfactory medical examination.

Application forms may be obtained by sending a stamped addressed foolscap envelope to the undersigned, to whom completed forms must be returned not later than Saturday, 14th February.

H. M. WALTON,
Secretary (F),
10, Great George-street,
6426 Westminster, S.W. 1.

Administrative County of London.

The London County Council invites TENDERS for the PURCHASE and REMOVAL of the undermentioned BOILERS and PUMPING MACHINERY at Western Pumping Station, viz.:—

Two Lancashire Boilers, 6ft. 9in. dia. by 22ft. long, with Mountings, Piping, &c.

One Horizontal Pumping Engine with steam cylinder 28½in. dia. by 5ft. stroke and driving through gearing Two Vertical Single-acting Bucket Pumps, 48½in. dia. by 5ft. stroke.

One Horizontal Steam Engine with cylinder 9in. dia. and 15in. stroke.

The specification, form of Tender, &c., may be obtained on and after Friday, 30th January, 1931, on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft, or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal enquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Friday, 13th February, 1931, will be considered.

The Council does not bind itself to accept the highest or any Tender.

MONTAGU H. COX,
6419 Clerk of the London County Council.

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

(1) MISCELLANEOUS ARTICLES and MATERIALS.

(2) HELICAL and VOLUTE SPRINGS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked:—"Tender for Miscellaneous Articles and Materials," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than 12 Noon on Friday, the 13th February, 1931.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of each specification.

Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
Westminster, S.W. 1,
28th January, 1931. 6440

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Metallurgist.
THE ENGINEER, 30 - 1 - 31.

The Nag Hammadi Barrage. (P. 123)
THE ENGINEER, 30 - 1 - 31.

High Pressure Locomotives. (P. 133)
(H. N. GRESLEY.)
THE ENGINEER, 30 - 1 - 31.

Enlarging the Kingsway Subway. (P. 136)
THE ENGINEER, 30 - 1 - 31.

Reinforcing a Railway Bridge. (P. 135)
THE ENGINEER, 30 - 1 - 31.

The Meopham Aeroplane Accident. (P. 135)
THE ENGINEER, 30 - 1 - 31.

High Voltage Testing. (P. 141)
THE ENGINEER, 30 - 1 - 31.

Lloyd's Register: Annual Summary. (P. 131)
THE ENGINEER, 30 - 1 - 31.

Agricultural Engineering. (P. 130)
THE ENGINEER, 30 - 1 - 31.

The Clacton Railway Accident. (P. 142)
THE ENGINEER, 30 - 1 - 31.

INDEX TO ADVERTISEMENTS, PAGE 83.

PUBLIC NOTICES

City of Nottingham.

The Works and Ways Committee are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES and MATERIALS, the Contracts to commence on the 1st April, 1931, and to terminate on the 31st March, 1932:—

A. Cement.
B. Blue Lias Lime.
C. Red Bricks.
D. Blue Bricks.
E. Timber.
F. Stoneware Pipes, &c.
G. Stoneware Pipes, &c. (Patent Joints).
H. Iron Castings, Iron Gullies, &c.
I. Yorkshire Flags, Kerb, &c.
J. Granite Setts, Kerb and Broken Granite.
K. Ironstone Slag, Chippings, &c.
L. River Gravel.
M. Concrete Sewer Tubes.
N. Picks, Shovels, Scoops, &c.
O. Ironmongery.
P. Scavenging and other Brushes.
Q. Limestone Chippings.
R. Refined Tar.
S. Pitch.
T. Creosote Oil.
U. Tarmacadam.

Forms of Tender may be obtained on applying to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of 5s. each, which will be returned on receipt of a bona fide Tender in accordance with the specifications, providing such Tender is not withdrawn and is delivered by the time stated below.

Patterns and samples may be inspected at the Eastcroft Works and Ways Depot, London-road, Nottingham.

The Committee will not consider any Tender except on the authorised form of Tender, which must be delivered to the undersigned, in the official envelope provided, on or before Monday, 23rd February, 1931.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from persons who conform to the conditions as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham District, applicable to the various trades.

By Order,
W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
23rd January, 1931. 6412

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for FIFTY COUPLING-RODS for H.M.S. Class Locomotives.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Thursday, 29th January, 1931.

A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than NOON on Tuesday, 10th February, 1931.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. GRANT,
6427 Secretary.

Trinity House, London.

APPLICATIONS are INVITED for APPOINTMENT to the POST of INSPECTOR of SHIPPING in the Department of the Surveyor of Shipping and Marine Engineer on the Headquarters Staff at Trinity House.

Candidates must be under 35 years of age; they must possess experience in shipbuilding and ship repairing (steel, iron and wood construction), and have had drawing-office experience.

Capacity (physically) for spending short periods afloat on lightships at sea for the purpose of preparing repair details is essential.

Salary £150 by £10 to £250 per annum, plus Civil Service "cost-of-living" bonus.

The post (subject to 12 months' probationary service) is permanent and pensionable on the Civil Service Scale, and the selected candidate will be required to furnish a certificate from the Trinity House Medical Officer as to his physical fitness.

Applications, with copies of references and full particulars of training and experience, to be made IN WRITING ONLY not later than Thursday, 19th February, 1931, to the SECRETARY, Trinity House, Tower-hill, London, E.C. 3, and marked outside "Application for Appointment as Inspector of Shipping."

Trinity House, London,
January, 1931. 6417

PUBLIC NOTICES

Great Western Railway.

The Directors of this Company are prepared to receive TENDERS for WIDENING the LINE between Filton Junction and Stapleton-road, Bristol (total length about 2¼ miles).

Plans may be seen and specification, forms of Tender and bills of quantities obtained, at the office of the Engineer at Paddington Station, between the hours of 10 a.m. and 4 p.m., on payment of Two Guineas, which will be returned to bona fide tenderers.

Tenders, addressed to the undersigned and marked outside "Tender for Filton Widening," will be received not later than 10 a.m. on Wednesday, the 18th proximo.

The Directors do not bind themselves to accept the lowest or any Tender.

F. R. E. DAVIS, Secy.

Paddington Station, London,
26th January, 1931. 6413

Government of Northern IRELAND.

CIVIL ENGINEERING APPOINTMENTS.

THE MINISTRY OF FINANCE invites APPLICATIONS for the APPOINTMENT of TEMPORARY ASSISTANT CIVIL ENGINEER. There are Four Vacancies, and the employment will, it is anticipated, last for at least Twelve Months.

CANDIDATES must hold a UNIVERSITY DEGREE IN ENGINEERING or, alternatively, be corporate MEMBERS OF THE INSTITUTION OF CIVIL ENGINEERS. Preference will be given to those with good Mathematical Qualifications and possessing an intimate knowledge of Hydraulics.

Applications, giving full particulars of qualifications, training and experience, and stating the salary required, should be made on the prescribed official form, which can be obtained from the SECRETARY, Ministry of Finance (Establishment Division), 15, Donegall-square West, Belfast, and should be returned, duly completed, so as to reach him NOT LATER THAN THE 11th FEBRUARY, 1931. 6414

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, CHIEF ENGINEER, to Take Charge of Maintenance of Mechanical and Electrical Machinery and Repair Shops in Paper Mill. Must have had experience of Large Marine Type Engines, High-speed Engines, and Mechanical Stokers. Young man with marine experience preferred.

Address, stating experience, age, and salary required, P710, The Engineer Office. P710 A

WANTED, CIVIL ENGINEERING DRAUGHTSMAN, with experience of Dock and River Works, Bridges, &c. Competent to make Finished Drawings from Sketches.—Address, giving age, full particulars of experience, salary required and copies of testimonials, 6438, The Engineer Office. 6438 A

WANTED, DESIGNING ENGINEER, not Over 30, for Mining Machinery; must have first-class education, both Practical, Theoretical, Mathematical and actual Practical Designing experience on own initiative.

Excellent prospects for right man.

Address, giving full particulars and salary required, 6439, The Engineer Office. 6439 A

AN Old-established FIRM of ENGINEERS REQUIRE a SALES ENGINEER for their Small and Medium-sized Automatic Refrigerating Plants. Applicants must have good general, technical and electrical knowledge and preference will be given to one with previous experience in Refrigerating Engineering.

Address, stating full particulars of training, experience and remuneration required, 6437, The Engineer Office. 6437 A

ENGINEERING COMPANY, Established South Africa and Rhodesia, acting as representatives for number of important engineering manufacturers REQUIRE for Head Office, Johannesburg, a technically trained and experienced ELECTRICAL ENGINEER, with some experience also Mechanical Engineering. Must have address and initiative, unquestionable ability successfully negotiate and service important engineering contracts and organise, develop and manage company's business. Age not under 35.—Address, stating fully record, experience, salary required, 6421, The Engineer Office. 6421 A

EXPERIENCED SALES ENGINEER REQUIRED, with good technical and practical qualifications, by a firm of Engineers manufacturing for Chemical and other Trades.—Address, giving full particulars, education, training, age and salary required, 6432, The Engineer Office. 6432 A

SITUATIONS OPEN (continued) Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 84.
EDUCATIONAL, Page 2.
MISCELLANEOUS, Page 2.
PATENTS, Page 2.
PARTNERSHIPS, Page 2.
BUSINESSES and PREMISES (For Sale, etc.), Page 84.
FOR SALE, Pages 2, 4 and 84.
AGENCIES, Page 2.
MACHINERY, &c., WANTED, Page 84.
FOR HIRE, Page 84.
WORK WANTED, Page 84.

For Advertisement Rates see Leader Page.

SITUATIONS OPEN (continued)

OLD-ESTABLISHED FIRM of HEATING ENGINEERS in Lancashire REQUIRE the SERVICES of a DRAUGHTSMAN, with experience of all Modern Systems of Heating, Hot Water Supply, Ventilating and Drying Plants. Applicants must be first-class Designers, with experience of Supervising Installations, quick and accurate and capable of Controlling Staff. To right applicant substantial commencing remuneration will be paid.
Address, in confidence, stating age, experience and salary expected, to 6436, The Engineer Office.
6436 A

REINFORCED CONCRETE DRAUGHTSMAN, Used to design his own work, WANTED by Consulting Engineer.—Address, stating age, experience, and salary required, P706, The Engineer Office. P708 A

REPRESENTATIVE.—Well-known Lubricating Oil Company REQUIRE ENGINEER-SALESMAN for the sale of High-grade Lubricants to industrial and commercial users.—Address, giving full particulars of experience, &c., 6434, The Engineer Office. 6434 A

REQUIRED IMMEDIATELY for a Railway in Spain, ASSISTANT to LOCOMOTIVE SUPERINTENDENT, to Supervise Repair Shops. Fluent Spanish essential. Salary Ptas. 12,000 per annum.—Write, giving age, experience, and copies of testimonials, to "F. C.," c/o Streets, 6, Gracechurch-street, London, E.C. 3. 6410 A

VACANCY in Old-established Engineering Works in North London for a young and energetic ENGINEER. Must be good draughtsman, capable of interviewing clients and negotiating for tenders and orders. Permanency with good prospects for suitable man with initiative. Knowledge of Steel Construction Work an advantage.
State age, qualifications, experience, and salary required.
Address, P707, The Engineer Office. P707 A

WORKS MANAGER WANTED for Modern Works in London district, employing 1000 hands, engaged in the Manufacture of Light Electrical Productions. Applicants should be young, energetic, and able to control labour.
Previous experience in similar capacity essential. Designing experience an advantage. Good prospects for right man. State age and salary required.
Address, 6433, The Engineer Office. 6433 A

WANTED, for Midland Colliery, an ASSISTANT MECHANICAL DRAUGHTSMAN. Full details of training and wages required, with copies of three references.—Address, 6442, The Engineer Office.
6442 A

WANTED, for Colliery in Yorkshire, Experienced DRAUGHTSMAN, able to Design General Colliery Plant. State experience, age and wages required.—Address, 6443, The Engineer Office. 6443 A

AN Experienced DESIGNER and ESTIMATOR for Centrifugal (Stage and Turbine) Pumps. Give full particulars of experience, age, and salary.—Address, P726, The Engineer Office. P726 A

CHIEF DRAUGHTSMAN REQUIRED, Thoroughly experienced in the organisation of drawing-office engaged in large variety of prime movers, both oil and steam.
Address, stating age, experience, and salary required, 6428, The Engineer Office. 6428 A

EXPERIENCED DRAUGHTSMAN, Competent to Design and Prepare Detail Drawings of Steel Buildings, Elevators, Conveyors, and Coal-handling Plant, REQUIRED at once. State particulars of experience, qualifications and salary required. Experienced men only considered.—Address, 6429, The Engineer Office. 6429 A

SITUATIONS WANTED

ABILITY, Energy, Initiative Offered by G.I. Mech. E. SEEKING CHANGE. Practical D.O. and commercial experience. Age 27. General engineering, castings, machine work, chemical plant, boilers, structural work, storage tanks, electrical. Mod. salary.—Address, P722, The Engineer Office. P722 B

AS PRODUCTION ENGINEER. Live Man with wide experience of up-to-date foundry and machine shop practice, planning, ratefixing, progress and costing: highest references.—Address, P667, The Engineer Office. P667 B

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COSTS and Works Accountancy. Highly Experienced MAN DESIRES ADMINISTRATIVE POSITION. Accurate production, process, and overhead costs, stores control, rate fixing, and general works and office organisation. Any size concern.—Address, P711, The Engineer Office. P711 B

ENGINEER INSPECTOR, M.I.E.I., A.M.I. Loco. E., age 29, SEEKS PROGRESSIVE POST, Foreman, Assistant Manager, &c. Thoroughly practical all branches; exp. mod. shop management, 2½ yrs. continental practice. Fluent German and French. Would represent British firm home or abroad. Ex. refs.—Address, P721, The Engineer Office. P721 B

ENGINEER, M.I. Mech. E., Iron and Steel Works' training, mechanical and electrical, practical in all branches, several years chief engineer and maintenance manager in large works in Midlands and in Sheffield, conversant with modern blast-furnace and steel works practice, &c., DESIRES SUITABLE POST. Age 43.
Address, P723, The Engineer Office. P723 B

EXPERIENCED ENGINEER OFFERS SERVICES as Resident or Visiting Engineer, Manager or Director. Has had first-hand experience in the following:—Docks, harbours, piers, dredging, narrow gauge and temporary railways, ropeways, inclines, bridges, buildings, foundations, masonry, concrete, waterworks, drainage, excavations, quarries, underground and opencast iron mines.—Address, P728, The Engineer Office. P728 B

EXPORT.—ADVERTISER, Desiring Greater Scope, OFFERS SERVICES, Foreign Sales Manager or similar; good technical and mechanical experience, extensively travelled, fluent French and German with good knowledge other languages; accustomed organisation, control and negotiation export business.—Address, P714, The Engineer Office. P714 B

FRANCE AND HER COLONIES. — CIVIL, MECHANICAL and MINING ENGINEER (British), having lived and worked for several years among the French as Manager for a London Company, is OPEN to TAKE UP a PERMANENT APPOINTMENT of an Administrative nature for a British firm involving Whole or Part-time Residence on French soil.—Address, P727, The Engineer Office. P727 B

SALES ENGINEER (33), B.Sc. Eng. (Lond.), A.M.I. Mech. E., expert knowledge of design, manufacture, sales and erection of Diesel and suction gas installations, sound knowledge of electrical and general power work, lately returned from responsible sales post in Brazil, fluent Portuguese, reads French and Spanish, REQUIRES POST, home or abroad. Exceptional references, moderate salary.—Address, P641, The Engineer Office. P641 B

SALES ENGINEER (35), Recently from S. Africa, WANTS COMMERCIAL APPOINTMENT to return. Considerable experience and local knowledge S.A. and Rhodesia.—Address, P715, The Engineer Office. P715 B

DRAUGHTSMAN (24), Experienced in General engineering, elevating and conveying, marine auxiliaries and refrig. plant, SEEKS POST.—Address, P712, The Engineer Office. P712 B

SITUATIONS WANTED (continued)

DRAUGHTSMAN (A.M.I.E.S.), Age 27, SEEKS POST as Assistant Engineer or Representative. Workshops and drawing-office experience, machine tool engineering and mechanical heating and ventilating. Excellent technical training.—Address, P706, The Engineer Office. P706 B

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PARTNERSHIPS

WANTED, PARTNERSHIP with Engineers' Agents or Factors in Northern Counties by Mech. Eng. (28). Mining and sales experience. Capital available £500-750. Own car.—Address, P717, The Engineer Office. P717 C

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MISCELLANEOUS

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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
22, Shakespeare House, 29-31, Oxford Street, London, W. 1.
P635 I

TYPEWRITING.—TESTIMONIALS by Return, 18 copies of one 1s. 6d., 50 copies 2s. 6d.; specifications, tenders, &c.—MISS GREENLAND (E), 40, Park-road, Westcliff-on Sea. P699 I

PATENTS

KING'S PATENT AGENCY, Ltd. (B. T. KING, Regd. Patent Agent, G.B., U.S., and Can.). Advice handbook and consultations on Patents and Trade Marks FREE.—146a, Queen Victoria-street, London, E.C. 4. 42 years' ref. 'Phone: Central 0682. 5839 B

PATENTS

THE OWNERS of BRITISH PATENT No. 283,854, relating to "Improvements in or relating to Ammunition Projectile Fuses," are DESIROUS of ENTERING into NEGOTIATIONS for the GRANT of LICENCES thereunder on reasonable terms.—For particulars address A. S. CACHEMAILLE, 2, Norfolk-street, Strand, London, W.C. 2. 6406 B

THE PROPRIETOR of BRITISH PATENT No. 246,709, dated May 20, 1925, relating to "Steam Joints for Revolving Cylinders or Pipes," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 6409 B

THE PROPRIETOR of BRITISH PATENT No. 261,577, for "Improvements in Machines for Forming Glassware," are DESIROUS of ENTERING into NEGOTIATIONS with interested parties for the GRANTING of LICENCES thereunder on reasonable terms or for the SALE of the PATENT outright.—Communications please address to Messrs. DICKER, POLLAK and MERCER, Chartered Patent Agents, 20-23, Holborn, London, E.C. 1. 6408 B

THE PROPRIETOR of BRITISH PATENTS Nos. 245,303, dated February 23rd, 1925, and 261,253, dated April 6th, 1926, relating to "Improvements in Pistons, Pump Plungers, and the like," and "Improvements in Plungers for Pumps and the like," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms for the purpose of exploiting the above patents and ensuring their practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 6425 B

THE PROPRIETORS of BRITISH PATENTS No. 194,201, relating to Roller Bearings, and No. 247,103, relating to Roller Bearings for Worm Shafts, are DESIROUS of ENTERING into ARRANGEMENTS with British Manufacturers with a view to the SALE or COMMERCIAL EXPLOITATION of the INVENTIONS protected by the said patents.—Interested parties are invited to communicate with REES, N. and W. S. SKERRETT, Patent Agents, 24, Temple-row, Birmingham. 6431 B

GERMANY.

Dipl. Ing. Walter Kuborn, of Ludwig Löwe Haus, Düsseldorf, begs to announce that he has established himself as a qualified

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5840 G

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In consequence of the recent amalgamation of "THE ENGINEER" LTD., proprietors of "The Engineer," with MORGAN BROS. (PUBLISHERS) LTD., proprietors of "The Ironmonger" and "The Chemist & Druggist," the offices of the three journals have now been transferred to new and more commodious freehold premises which have been acquired at 28-31, Essex Street, Strand, W.C. 2.

The remainder of the lease, covering a further twenty-five years, of the offices of "The Engineer" at 33, Norfolk Street, Strand, W.C. 2, is in consequence for sale. This particularly well lighted five-storey building has an area of 8,200 sq. ft., and occupies a site at the corner of Norfolk and Howard Streets, adjacent to the Temple Station, whence Westminster and the City may be reached in a few minutes. The building is of modern construction and has a fine and distinctive elevation. It is in good order throughout, and vacant possession can now be had. Rent £1,600. Moderate price. For further particulars apply to:—

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For continuation of For Sale Advertisements see page 4.

A Seven-Day Journal

The Melchett Medal.

THE late Lord Melchett, the Founder-president of the Institute of Fuels, gave to the Institute some months ago sufficient money to found a medal in perpetuity. It is to be awarded annually to such person, whether a member of the Institute or otherwise, who, in the opinion of the Council, has done either original research or professional, administrative or constructive work of an outstanding character, involving the scientific preparation or use of fuel, provided the results of such work have been made available within recent date for the benefit of the community. The award is made without restriction as to the nationality of the recipient. The first Melchett Medal was presented last Friday to Dr. Kurt Rümmel, by Sir David Milne-Watson, the President of the Institute of Fuel, in the lecture theatre of the Institution of Civil Engineers, and the ceremony was followed by the delivery of the first Melchett Lecture, in which Dr. Rümmel dealt with the calculation of the thermal characteristics of regenerators. Subsequently, a complimentary dinner to Dr. Rümmel was given at the Connaught Rooms. In presenting the Medal, the President said that Dr. Rümmel's name would be primarily associated with the world-famous Warmestelle, at Düsseldorf, which was formed in 1919, at a time when the German iron and steel industry was labouring under great difficulties and when it was necessary to practice economy in every direction. Dr. Rümmel had founded that institution for the express purpose of reducing costs of fuel, and to-day it employed no less than a thousand fuel technologists. Through the instrumentality of the Warmestelle, the average cost of fuel in the German iron and steel industry had been reduced by 15 per cent. The President added that Dr. Rümmel had not kept his scientific knowledge to himself, but had contributed many papers on iron and steel works practice, coking, and power generation and transmission for the benefit of industry.

National Economy.

ON Tuesday last a great meeting at the Cannon-street Hotel opened a campaign organised by a body known as "The Friends of Economy," whose object is to arrest extravagant expenditure by the Government and local authorities. The principal speakers were Lord Grey of Fallodon, Sir Robert Horne, and Sir Ernest Benn. All the speeches were admirable, but that by Sir Robert Horne may be picked out for special mention, as it showed by striking figures the crippling nature of the taxation which extravagance had imposed upon the country. At the conclusion of the meeting it was resolved :—(1) That the revival of the true spirit of economy in national, local, and personal affairs is necessary to the recovery of prosperity. (2) That in view of the injurious effects upon trade and industry of the burden of national and local taxation by withdrawing resources from use in business and thus directly contributing to unemployment, this meeting of the citizens of London (*a*) calls upon the Government and local authorities to cease from all expenditure which is not absolutely necessary, and, further, (*b*) urges the citizens of other towns in the country to hold similar meetings and thus to make it clear to those in authority that the nation declines any longer to be committed to inevitably disastrous courses.

Telephone in the London Area.

ACCORDING to a statement just issued by the Post Office, during 1930 there was a considerable increase in the number of telephones in the London area. Advances were also made in the methods of transmitting speech, with the result that the general quality of transmission was improved. There is, however, one matter, the report states, in which no advance in scientific knowledge can effect an improvement, and that is the problem of the subscriber who will not direct his voice to the transmitter, but turns his face away. The effect of this practice is equivalent to the addition of many miles of distance between the subscribers and largely nullifies the technical improvements which have been made. The listening subscriber frequently blames the apparatus or lines for his inability to hear speech when the fault is really due to the speaker. The new hand microphone, which is now available to the public at an additional rental of 2s. a quarter, combines the transmitter and receiver in one piece of apparatus, and is of material value in promoting comfort and convenience, particularly when the speaker has to write or turn up records during his conversation. About 13,500 of these instruments are in use in the London area, and the number is rapidly increasing. The number of "phonograms"—*i.e.*, telegrams sent in by or delivered to the public by telephone—continues to increase. The number of "phonograms" received at the Central Telegraph Office exceeded 2,290,000, and the number of telegrams delivered by telephone exceeded 1,150,000. With reference to automatic exchanges, it is stated that further development of the automatic system, and the fact that subscribers are rapidly adapting themselves to the new conditions, have resulted in a marked improvement in the results obtained. Extensive observations show that while a high percentage of calls dialled are fully effective at the first attempt, a number are ineffective because the called subscriber does not answer in time or for other reasons. In such cases, by making a second or at times even a third attempt, a subscriber could get into communication with his correspondent quite as promptly as by reference to the operator.

The Late Mr. Montague Stanley Napier.

IT is with regret that we have to record the death, at the comparatively early age of sixty years, of Mr. Montague Stanley Napier, the chairman of D. Napier and Sons, Ltd., of Acton Vale. Mr. Napier had been an invalid for many years, and his death took place at Cannes on Friday of last week, January 23rd. For some years past he had been residing in the South of France, but his interest in internal combustion engine design was still keen, and he continued to produce ideas and designs which he discussed with members of his firm. His early training was received in the Napier works, which, it may be recalled, were moved from the Clyde in the second half of last century. The high traditions of sound marine engineering design were applied by Napier's to the high-speed internal combustion engine, and with the building of the Acton works the manufacture of motor car engines was begun. Previous to that time the firm had been employed in the manufacture of fine engineering work, including coin-weighing machines. From 1899 to 1902, when a Napier car won the Gordon Bennett Trophy, attention was devoted to the production of motor car engines, and in the years up to the war many cars and engines were produced which gained both speed and endurance trophies. After the early years of the war, Napiers were called upon to build aero-engines for the Government, and in 1918 the firm's "Lion" aero-engine was produced, which was a water-cooled engine with twelve cylinders arranged in three rows. In its modern form it is designed to develop about 530 H.P. The Napier aero-engines were modified for use in the Schneider Trophy seaplanes, and one of these, the "Supermarine Napier" machine, won the 1927 race. The firm is now engaged in the production of an entirely new type of Napier engine for aircraft, which will, it is understood, have sixteen cylinders arranged on four banks, and will be air cooled.

Short Wave Wireless Installation on the Oropesa.

Now that the Prince of Wales has passed Bermuda, the range of the normal ship wireless installation is insufficient to keep him in direct touch with Great Britain, but the Marconi short-wave transmitter and receiver which was specially installed for the Prince's use on the Pacific Steam Navigation Company's liner "Oropesa," on which he is travelling, will enable him still to maintain constant and direct communication with this country through the short-wave wireless coast station at Portishead, near Bristol. Although a considerable number of ships now carry short-wave equipment for direct communication over long distances, no ship fitted with short-wave apparatus for communication with England has as yet made the voyage along the South American coast, but experience in short-wave communication at sea indicates that at no time during the voyage should the Prince of Wales find any difficulty in maintaining direct communication with England. Whilst docked in London, the Australian liner "Jervis Bay" has communicated direct with Sydney, and the Royal Mail liner "Asturias" regularly exchanges messages with the Portishead station when off Buenos Aires. While the short-wave wireless set on the "Oropesa" is carrying out communication with Great Britain, the normal wireless equipment will be used for navigation and the exchange of messages with local ship and shore wireless stations on the run through the Caribbean Sea, the Panama Canal, and down the South American coast.

New Union-Castle Motor Liner.

TO-DAY—Friday, January 30th—the new Union-Castle motor liner "Warwick Castle" leaves Southampton on her maiden voyage in the South African mail service. She is a sister to the "Winchester Castle," which has now been in service for some months, and which was fully described in our issue of October 17th last. Like the other mail and intermediate motor liners of the Union-Castle fleet, the new ship was built and engined by Harland and Wolff, Ltd. She has a length of 650ft., and is 20ft. longer than the "Winchester Castle," while her mounded breadth is 75ft., her moulded depth 44ft. 6in., and her measurement about 20,500 gross tons. She is propelled by a twin-screw installation of eight cylinder, four-stroke, double-acting oil engines of the Harland-B. & W. type, which have a rated output of about 13,800 S.H.P. at 98 r.p.m., corresponding to a normal sea speed of about 15¾ knots. Prior to handing over, very successful speed and measured-mile trials were carried out. The accommodation is arranged for 760 first, second, and third-class passengers, and most of the rooms have single or double berths. There is a series of special single-berth state-rooms, with adjoining sitting-rooms and bathrooms, which can be conveniently arranged as may be required for passengers travelling singly or in parties. The main public rooms are very generously dimensioned, and a modern style of decoration has been chosen, with very pleasing results. The decoration and furnishing of the ship was entrusted to Heaton, Tabb and Co., Ltd., of Cricklewood and Liverpool, to designs prepared by Mr. Ashby Tabb. A feature of the cargo-carrying arrangements is the large amount of insulated space available for the carriage of fruit and other perishable cargoes, and the commissioning of the new liner will undoubtedly stimulate South African trade.

Krupps Annual Report.

THE Fried. Krupp A.G., at Essen, has now issued its annual report for the financial year 1929–30. Although it was generally realised that the dividend would be passed, some surprise was caused when it was found that the balance sheet showed a loss of 4,400,000 marks (£220,000). This is reduced to 2,530,000 marks by the profit of 1,920,000 marks carried forward from last year. In the preceding year the company had made a net profit of 6,910,000 marks. In the annual report of the company it is revealed clearly by the developments in its coal, steel and iron business that these German industries cannot be carried on at a profit unless really effective measures are taken to reduce the costs of production. The construction of locomotives was again carried on at a loss, and, in spite of the order for eighteen engines recently received from the German railways, the company sees little hope of the position improving. A profit was, however, made out of the turnover in machines, motor lorries, and register tills, the last-named being the most successful. The balance sheet does not give definite figures of the turnover, but reliable estimates show that in the previous year it was 550,000,000 marks, and suggest that it must have declined by about 60,000,000 marks in 1930. The firm still has bank debts outstanding to the amount of 30,000,000 marks. The share capital of the concern is 160,000,000 marks.

Southampton Master Mariners.

AN interesting event took place on Monday evening last, January 26th, when the Southampton Master Mariners' Club (the Cachalots) held its third annual banquet, the first aboard ship, which, by the invitation of the Cunard Steamship Company, Ltd., took place on the "Aquitania." The Club was founded some years ago to foster friendship among ship masters, and with a membership of 100 at the beginning, it has to-day close upon 480 members, including the master mariners of American, German, and Dutch ships. The toast of "Our Sea Service" was proposed on Monday evening by Major-General Seely, the guest of the evening, and Sir Roger Keyes replied for the Royal Navy. Sir Roger expressed his unbounded faith in the sea spirit of our country, and went on to give some comparative figures of man power in the British and other Navies. In 1914, he pointed out, there were 146,000 men in the Royal Navy, whereas we now had only 90,000 odd. Similar figures for America were 67,000 in 1914 and 114,000 to-day ; while in 1914 Japan had 50,000 and now had 85,000. He expressed his dissatisfaction with these figures, and suggested that our country should understand that its safety depended on its great sea service.

The Railwaymen's Pay.

ON Monday, January 26th, the National Railway Shopmen's Council met in London to hear the counter-claims of the unions to the proposals of the companies for wage reductions. It will be recalled that the companies urge that their wages bills have increased 143 per cent. since 1913, while the general level of wages has increased by only 70 to 75 per cent. and the cost of living is only 55 points up. The reductions they are asking for are 4s. 6d. a week in the case of men on time rates and 6s. 6d. in the case of pieceworkers. The unions have now made a joint counter claim for a minimum wage of £3 per week for all adult workmen ; the consolidation of the existing war bonus in the basis rates ; a consequential increase to higher grades to maintain differentials ; an increase of the wages of juniors according to a scale ranging from 20s. a week at fifteen years of age to 60s. at twenty ; a guaranteed day's pay ; and a twelve days' annual holiday with pay. In addition, a guaranteed week of forty-seven hours, excluding Sunday, is claimed by the National Union of Railwaymen, but the other unions are not in agreement with it as to the advisability of this measure. They prefer short-time working to avoid dismissals during slack periods. The railway general managers were unable to agree to the proposals put forward by the unions, and pressed the unions' representatives to agree to the proposal of the companies that the question of the reduction of the war wage should be referred to the Industrial Court. The union representatives undertook to report back to their executive committees. The result of the investigation of the claims of the clerical grades now being carried on before the National Wages Board should have a direct bearing on the claims in respect of the shopmen.

THE NAG HAMMADI BARRAGE ON THE NILE

MESSRS. COODE, WILSON, MITCHELL AND VAUGHAN-LEE, MM. INST. C.E., WESTMINSTER, ENGINEERS

(For description see opposite page.)

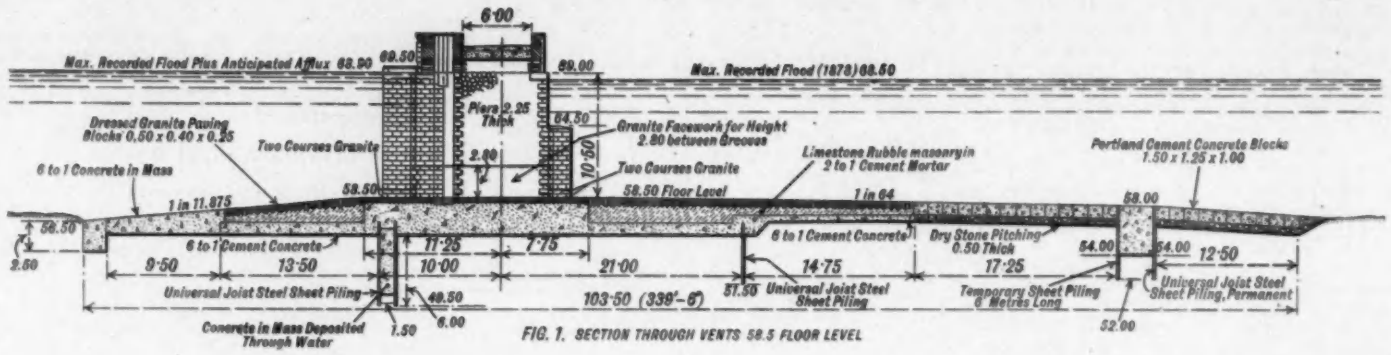


FIG. 1. SECTION THROUGH VENTS 58.5 FLOOR LEVEL

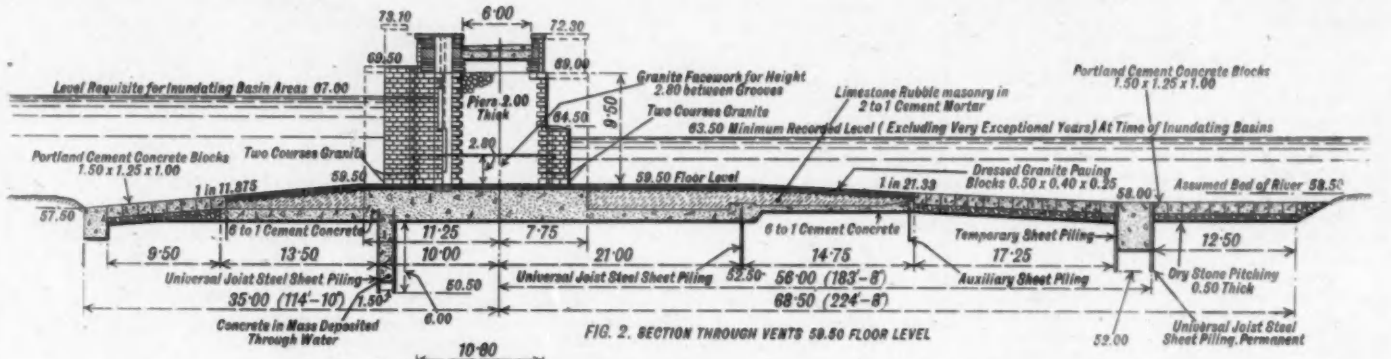


FIG. 2. SECTION THROUGH VENTS 59.50 FLOOR LEVEL

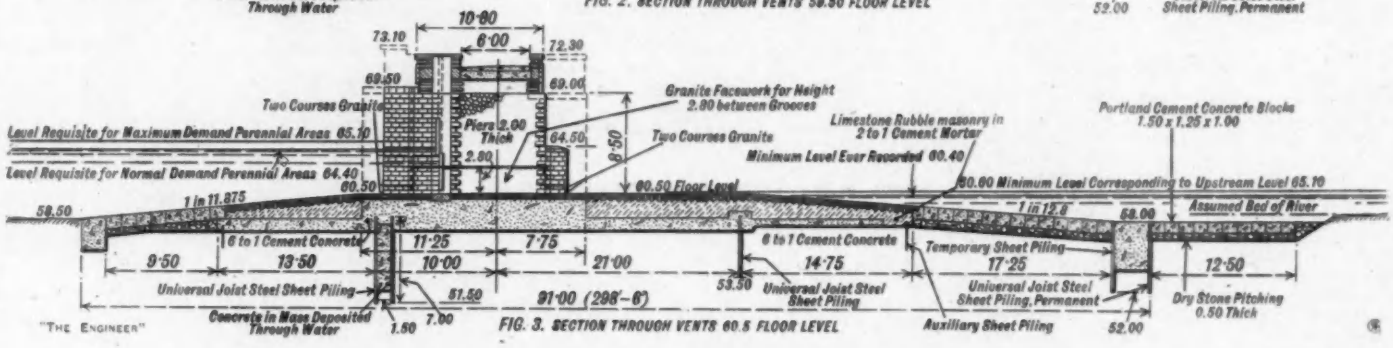


FIG. 3. SECTION THROUGH VENTS 60.5 FLOOR LEVEL

FIGS. 1, 2, AND 3.—TYPICAL CROSS SECTIONS OF THE BARRAGE AS ACTUALLY CONSTRUCTED

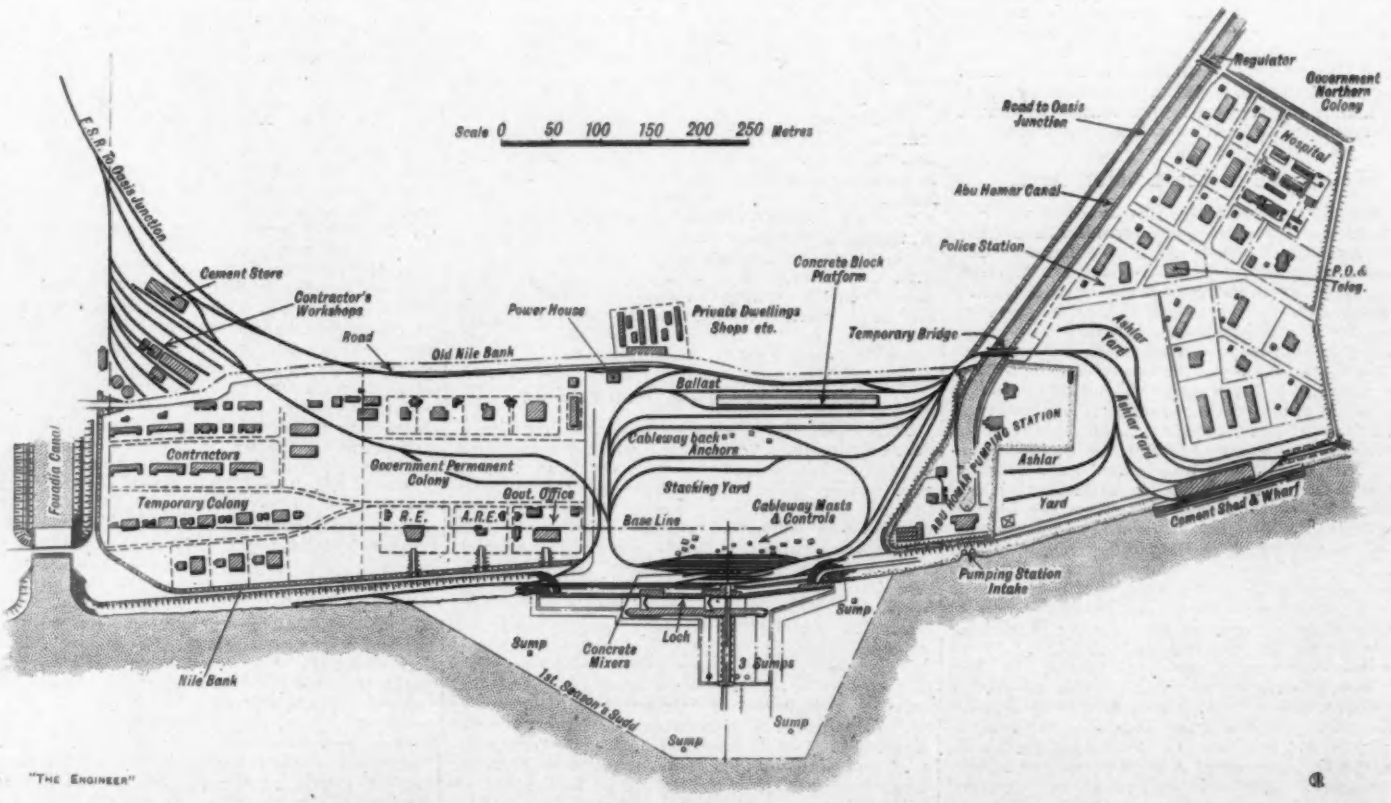


FIG. 4—ARRANGEMENT OF BUILDINGS AND RAILWAYS ON WEST BANK

The Nag Hammadi Barrage.

No. I.

IN our issue of September 2nd, 1927, we published a description of a barrage which was then to be constructed for the Egyptian Government across the Nile at Nag Hammadi, in Upper Egypt, the contract for which had been entered into in May of that year with Sir John Jackson, Ltd. This structure was completed during the last working season and was formally opened on Friday, December 19th, 1930. In what follows we are enabled, through the courtesy of the engineers for the project—Messrs. Coode, Wilson, Mitchell and Vaughan-Lee—to give the following additional information.

Our readers will remember that this barrage is one of a number of schemes devised to provide better irrigation for Upper Egypt, and an increased supply of water for Egypt generally. It is situated nearly half-way between the Esna, or Isna, and the Assiut Barrages, some 367 miles from Cairo, and 9 miles below the town of Nag Hammadi, where the main line of the Egyptian State Railways crosses the river on a steel girder bridge with a swing opening span. The site on which it has been constructed was chosen by Sir Ismail Sirry Pasha, K.C.M.G.—at one time Minister of Public Works. It is situated at the lower end of a long, straight reach of the Nile, where the River is of comparatively narrow width, and has firm banks on both sides which afford an ideal approach to the barrage for the flow of the river.

When, in November, 1926, the Egyptian Government advertised for tenders for its construction, it received nine tenders—two British, two French, two Italian, two German and one Egyptian. These tenders varied in amount from £1,976,555 to £3,134,344, the lowest tenderer being Sir John Jackson, Ltd., of Westminster, and a contract to carry out the work was entered into with that firm. It is worthy of putting on record that the estimate of the Consulting Engineers was £1,999,000, which approximates very closely to Messrs. Jackson's tender.

Although we entered in considerable detail into the design and construction of the Barrage in our issue above referred to, we may, perhaps, here repeat something of what we then said, in order that the present article may be the more complete in itself. In the first place, it may be explained that the structure is founded entirely on sand. Borings taken down to a depth of about 43ft. 6in. below the bed of the river showed that no rock exists down to that depth over the whole length of the barrage site. For some 7ft. 3in. below the surface there was found to be a layer of white fine sand. Then there came just over 6ft. of white coarse sand with pebbles and then white sand again for some 19ft. 6in. Below that there were 5ft. 6in. of fine white sand with pebbles and below that, till the bottom of the bore-hole, nearly 5ft. of fine white sand.

The total length of the barrage between the centres of the abutment piers is 822·25 m., or very nearly 2700ft., while the total length, if the lock at the western end be included, is 876·35 m. The overall width of the barrage floor is no less than 339ft. 6in., while the width of solid floor is 194ft. 6in. These figures compare with a total width of 283ft. 9in. and a solid floor width of 100ft. 3in. in the Isna Barrage, and with a total width of 218ft. and a solid floor width of 99ft. 6in. in the Assiut Barrage. In all these three barrages sheet piling is employed for their full length, the piling being arranged both upstream and downstream of the axis of the structure. A departure was, however, made in the case of the Nag Hammadi Barrage. In both the Assiut and Isna Barrages, the piling was of cast iron, but in the Nag Hammadi universal joist steel sheet piling was employed. On the upstream side the main piling is arranged at a distance of 10·0 m. from the axis, whereas, on the downstream the distance from the axis is 21·0 m.—or, say, 69ft. On the upstream side the piles were driven down to 6·0 m. below the lowest part of the concrete in the dam foundation. On the downstream side they were only driven down to 4·0 m. below the lowest part of the concrete. On the downstream side there is just a single line of this main piling, but on the upstream side there are two lines of piling arranged at 1·5 m. centre to centre apart, the space between them being filled to a depth of 5·50 m. with mass concrete, and the heads of the piles being left 1 m. proud so as to project up into the concrete of the floor. In effect, therefore, there is a solid wall of concrete, very nearly 5ft. thick and some 18ft. deep, and more in places, stretching across the river from bank to bank and forming one piece with the solid floor of the barrage. At the western end of the barrage, where, as explained in the article referred to above, two groups of 10 vents are arranged at lower levels, in two steps of 1·0 m. each, than are those of the remainder of the barrage, the depths to which the upstream piles were driven were 50·5 O.D. and 49·50 O.D. in the two steps respectively, while the downstream depths were 52·50 O.D. and 51·50 O.D. respectively. In the remainder of the barrage the upstream and downstream depths are 51·0 O.D. and 53·50 O.D. respectively. The bed of the river, it may be mentioned, varies from about 62·0 O.D. to 58·0 O.D.

The maximum depth to which the barrage foundation had to be excavated was about 21ft. 6in., but over the greater length the depth of excavation averaged between 6ft. 6in. and 9ft. 6in. Everywhere, however, the excavated depth was such that there

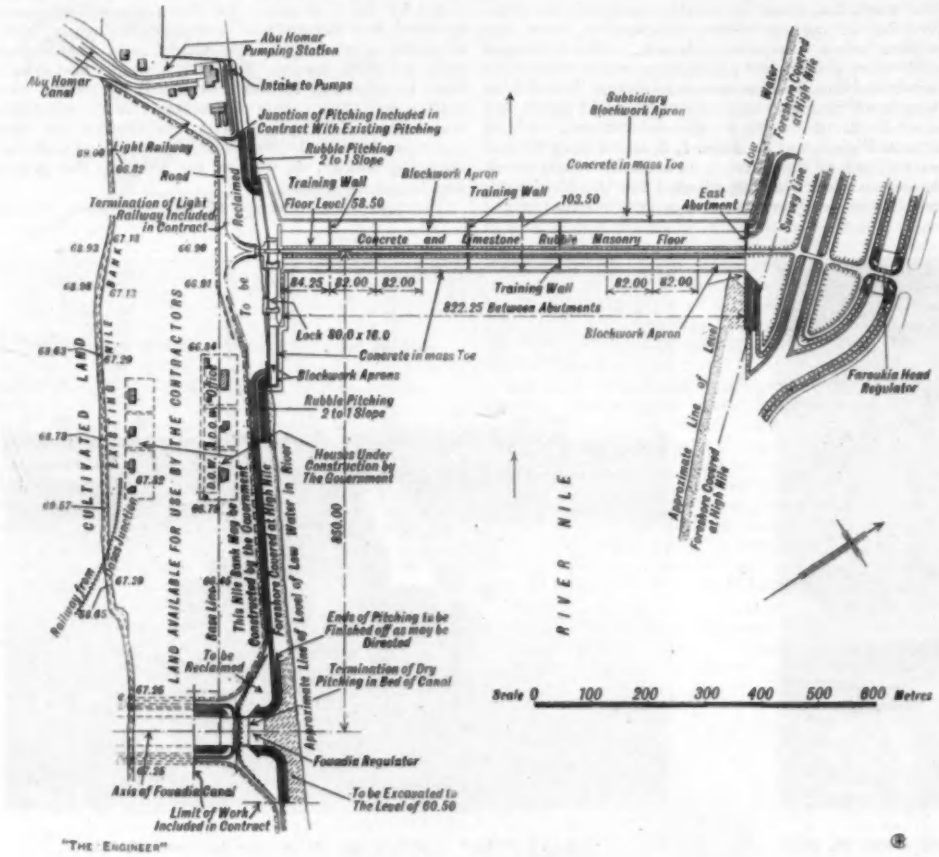

Abu Homar Pumping Station
Abu Homar Canal
Intake to Pumps
Junction of Pitching Included in Contract With Existing Pitching
Rubble Pitching 2 to 1 Slope
Light Railway
Road
Training Wall
Floor Level 58.50
Blockwork Apron
Training Wall
103.50
Subsidiary Blockwork Apron
Concrete in mass Toe
East Abutment
Low Water Foreshore Covered at High Nile
Survey Line
Termination of Light Railway Included in Contract
Reclaimed
Concrete and Gunestone Rubble Masonry Floor
84.25 82.00 82.00
Training Wall
82.00 82.00
822.25 Between Abutments
Lock 80.0 x 16.0
Concrete in mass Toe
Blockwork Apron
Blockwork Aprons
Rubble Pitching 2 to 1 Slope
Farcukia Head Regulator
CULTIVATED LAND
LAND AVAILABLE FOR USE BY THE CONTRACTORS
To be Reclaimed
Heading Under Construction by The Government
Approximate Line of Low Water Foreshore Covered at High Nile
RIVER NILE
Railway Line
Base Line
This Nile Bank May be Constructed by the Government
Ends of Pitching to be Finished off as may be Directed
To be Reclaimed
Termination of Dry Pitching in Bed of Canal
Approximate Limit of Level of Low Water in River
Foundation Regulator
Axis of Foundation Canal
To be Excavated to The Level of 60.50
Limit of Work Included in Contract
Scale 0 100 200 300 400 500 600 Metres
"THE ENGINEER"

FIG. 5—GENERAL PLAN OF WORKS

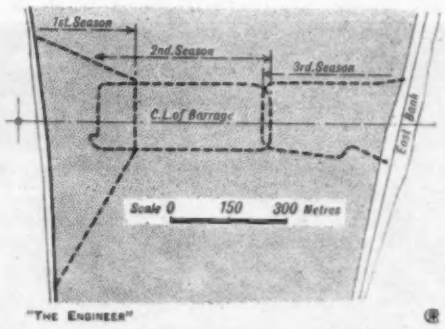


FIG. 6—THREE SEASONS' SUDDS

FIG. 7—UPSTREAM FOUNDATIONS OF LOCK—MARCH 3, 1928

FIG. 8—DOWNSTREAM FOUNDATIONS OF LOCK—MAY 14, 1928

is at least 9ft. 10in. of 6 to 1 cement concrete beneath the structure of the barrage.

In the full length of the barrage there are 100 sluice openings, each having a width of 6 m. The combined width of opening is, therefore, 600 m., or just over 1968ft. Each opening is furnished with two independently-operable sluice gates, these gates being either 6·1 m., 7·1 m., or 8·1 m. deep, according to their position in the barrage. The gates are operated, or withdrawn, if necessary, by means of two travelling power-driven overhead machines of the Goliath type. The 100 openings are formed into ten groups or panels of 10 each, by means of two abutments and nine main piers, each 4·0 m. wide. The intermediate piers are all 2·0 wide, saving those of the extreme western panel or group, which are 2·25 m. wide.

Except for their width and height, all the piers are very much of the same construction. Most of them will be 8·5 m. high to the springing of the arches which join their summits together. The lower courses of all the piers for a depth of 2·40 m. are faced with dressed granite, but the face work for the remainder of the height of all the piers is of dressed limestone ashlar and limestone blocks set in mosaic fashion. The hearting of all the piers behind the facing stones is of limestone rubble masonry set in 2 to 1 cement mortar. The arches joining the piers are struck to a radius of 4·35 m. and have rises of 1·2 m. The voussoirs are faced with finely dressed limestone blocks, and the arches are formed of 4 to 1 cement fine granite concrete. The piers forming the deeper sluice openings at the extreme western end of the barrage are 10·5 m. high to the springing of the arches, and the piers between them and the 8·5 m. piers are 9·5 m. high. The 2·0 m. intermediate piers are 15·58 m. or 51ft. in length, while the 2·25 m. piers are 15·915 m., or 52·2ft., in length. Each is furnished on each side with a vertical recess 1·55 m. wide and 0·36 m. deep for the reception of the cast iron grooves for the sluice gates. In addition, each pier has, near its ends at each side, safety grooves, 0·4 m. wide and 0·30 m. deep, for the insertion of stop logs. Drawings of the abutment and intermediate piers were given in our issue of September 2nd, 1927, and no further description of them need be given in the present instance. We may say, however, that a roadway, 6·0 m. wide, runs from end to end of the barrage, and on it is laid a 0·60 m. gauge line of rails of the tramway type. The rails on which the winches for operating the sluices run, which weigh 80 lb. per yard, are set at 2·5 m. centres and are fixed on limestone coping blocks, the top surfaces of which are at an elevation of 72·30 O.D.

At the western—or, more correctly perhaps, the south-western, for the structure runs nearly S.W. and N.E.—end of the barrage there is a lock for the passage of river craft. It measures 80 m.—say, 262ft. 6in.—in length by 16·0 m.—say, 52ft. 6in.—wide, while the depth from the coping of the walls to the floor is 10·50 m.—say, 34ft. 5in.—so that it can pass vessels of considerable size. Its sill stands at 58·50 O.D., which is the same level as that of the floors of the lowest sluices in the barrage. The wall dividing the lock from those sluices is 11·80 m. thick and is built of limestone rubble masonry set in 3 to 1 mortar, with limestone mosaic facing set in 2 to 1 mortar. Its other wall, which is 13·70 m. thick, is of similar construction. On the side of that wall away from the river steel sheet piling was driven down to 51·50 O.D. In each wall there is a main and a flushing culvert, each with rounded tops and each measuring 1·20 m. wide by 1·80 m. maximum height. These openings are controlled by sluice gates working vertically in grooves, which are operated by hand-worked gear arranged at ground level. The lock gates, which are of mild steel, swing back into recesses formed in the side walls, with which, when opened, they are flush. The machinery for opening and shutting the gates is also hand operated, and is contained in pits formed in the surface of the side walls. The lock is spanned at the downstream end by a mild steel swing bridge with its centre line, when it is closed, coinciding exactly with the centre line of the barrage, and having the 0·60 m. gauge line continued across it. The total length of the bridge, which is also operated by hand-worked gearing, is 29·50 m.—say, 96ft. 9in.—its longer portion—that which spans the lock—being 21·50 m. in length.

The work has been executed practically as illustrated in our article above referred to, with the exception of a few minor details. The principal modification was in the foundation, where two lines of mild steel sheet piling were added, one line of 3 m. in length at the upstream end of the solid apron and one of 2 m. of length at the downstream end, as shown on Figs. 1 and 3. Figs. 1, 2, and 3 show typical cross sections of the barrage as actually constructed. Concrete in mass was substituted for the blockwork apron in the western ten vents at the request of the contractors. This is shown on Fig. 1. These additional lines of piles were the result of the experience gained during the first season's work when the floor, aprons, and piers of the ten western vents of the barrage were constructed, as it was found that it was necessary to confine the sandy materials forming the foundations to prevent seepage water drawing out the sand from beneath the concrete.

This addition is more necessary on the eastern portion of the barrage, as it will be seen from Figs. 2 and 3 that the blockwork permeable aprons were more sloping than in Fig. 1, and the risk of the foundation being undermined was greater.

Another addition was the introduction of training walls at piers 10, 40, and 60, but these walls were asked for and were constructed by the contractors, with the consent of the Government, to allow the former to arrange their temporary dams in a manner most convenient to themselves, and were, to all intents and purposes, portions of the temporary works. These training walls were allowed to remain in position.

In addition to the large masonry regulator at the head of the Fouadia Canal, 850 m. above the barrage on the west bank of the river, the Government decided to construct a smaller regulator of three vents, each 6 m. in width, on the east bank of the river, for the headworks to the Faroukia Canal, and this latter work was included in the work allotted to the contractors for the barrage. In Fig. 5 we indicate the position of this headwork and the remodelling of the intakes of the canals and works on the east bank. Our readers will be able to see the nature of the alterations from the original plan by comparing this drawing with Fig. 8 which was given on page 254 of our issue of September 2nd, 1927. The positions of the three seasons' sudds are given in Fig. 6.

During the summer and autumn months of 1927 the contractors built and equipped their temporary colony and workshops in the vicinity of the Fouadia Canal, and the Government laid out its northern temporary colony containing the post office, the police station, and blocks of living quarters. In addition, this latter colony contained the hospital, which, under the contract, had to be provided and equipped by the contractors. The contractors also constructed a wharf and erected cement sheds and began the erection of the five overhead cableways across the river. These, however, were not all completed till the summer of 1928, but were brought into use from time to time as they became available, the last being put in commision on June 16th. A description of these cableways appeared in our issue of September 14th, 1928. They also erected an electric power station for operating the cableways, pumping plant, and other fixed machinery, as well as for the lighting of the colonies and works generally. Fig. 4 shows the lay-out of the establishments on the west bank of the river, which included a canteen, recreation room, open-air cinema, and hard tennis courts.

The contractors opened out again the old quarries at Issawiya, some 60 kiloms. downstream of the barrage, whence the limestone ashlar had been obtained for the Assiut Barrage. This material was dressed at Issawiya and transported to Nag Hammadi by river, shallow draught tugs and barges being provided by the contractors for this purpose. A quarry for sand and shingle was opened at Marashda, about 40 miles upstream of the works, and granite was obtained from Assuan. The sand, shingle, and granite were transported to Nag Hammadi by native river craft. An inferior class of limestone for pitching, &c., was obtained locally. The contractors let sub-contracts for all quarrying and the supply of materials obtained locally, as well as for dressing the granite and limestone ashlar.

Through the courtesy of the engineers for the barrage works we are able to reproduce some photographs of the works, showing the progress of the work from time to time. Fig. 7 shows the upstream half of the foundations of the lock, with the southern colony in the distance taken on March 3rd, 1928. The foundation stone, laid by his Majesty King Fouad, can be seen in the left centre of the picture. Fig. 8, taken May 14th, 1928, shows the downstream portion of the lock foundations with the steel piling and the concrete foundations in progress. The Abu Homar pumping station, the northern colony and the contractor's wharf, water tanks, and cement shed, are seen in the background. Fig. 9 shows the foundations of the first ten vents of the barrage under construction on June 29th, 1928, with the walls of the lock in the foreground. The outlines of the first two or three piers of the barrage can be distinctly seen. This view also shows the greater portion of the area enclosed by the 1928 sudd. Fig. 10 shows the first eight piers of the barrage and a portion of the walls of the lock all completed to their full height on August 17th, 1928. The western masts of the five cableways, each about 180ft. in height, can also be seen. Fig. 11, page 134, taken on Jan. 30th, 1929, shows the temporary dam surrounding the second season's work, the first 10 arched openings of the barrage and work commencing in the foundations beyond these. The nine pontoons, each containing two pumps, can be distinctly seen. Fig. 12 is a similar view to the last, but taken three months later on May 4th. Some more photographs will be reproduced with the second part of this article.

(To be continued.)

FIG. 9—FOUNDATIONS FOR FIRST 10 VENTS OF BARRAGE—JUNE 29, 1928

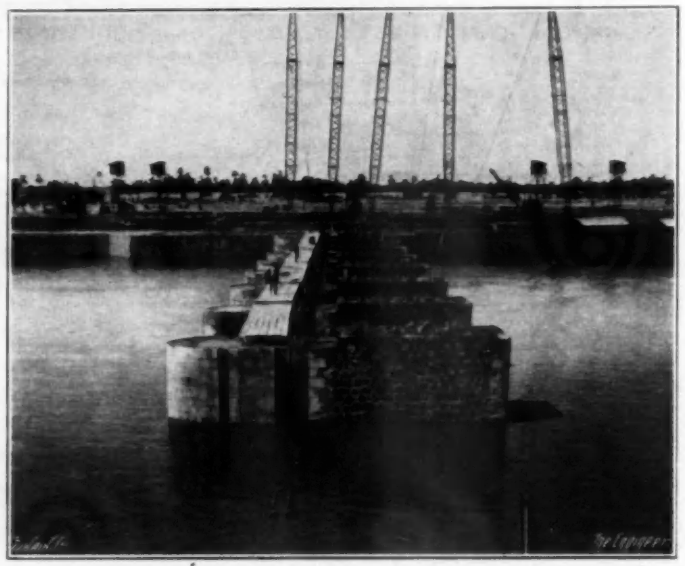


FIG. 10—FIRST 8 PIERS OF BARRAGE—AUGUST 17, 1928

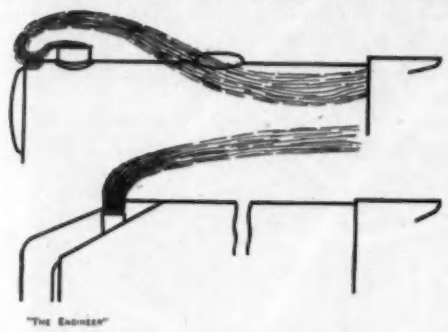
Institution of Mechanical Engineers.

HIGH-PRESSURE LOCOMOTIVES.

ANY paper on locomotives can always be relied upon to attract a large audience at the Institution of Mechanical Engineers. Last Friday, when Mr. H. N. Gresley presented his eagerly anticipated paper on "High-pressure Locomotives," fully illustrated this characteristic. Every available seat in the body of the hall and in the gallery was occupied, and some members had to be content with seats on the steps. Mr. Gresley's paper divided itself naturally into two portions, of about equal length. In the first, reproduced in full elsewhere in this issue, he dealt with American, German and Swiss designs of high-pressure locomotives, including the London, Midland and

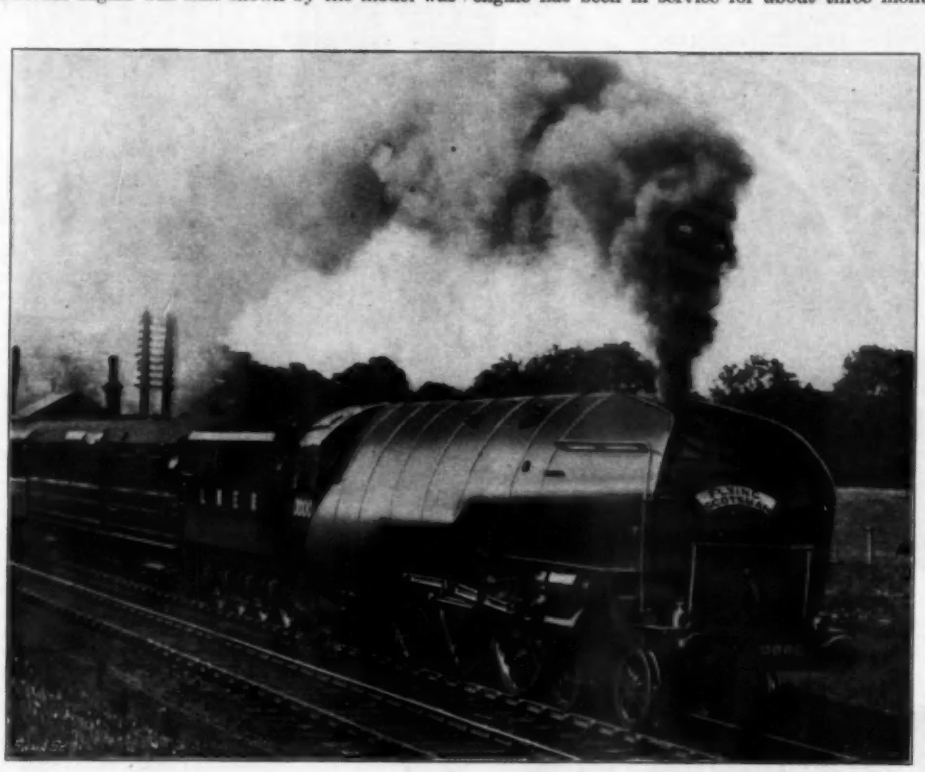
Scottish Company's engine "Fury," a locomotive of the Schmidt type. In the second portion of his paper, which we hope to reprint next week, Mr. Gresley described in detail the Yarrow-Gresley locomotive "No. 10,000," which he has recently put into service on the London and North-Eastern Railway.

Supplementing his remarks concerning the course taken by the smoke and steam on leaving the chimney of a locomotive, Mr. Gresley sketched on the blackboard the diagrams reproduced herewith. Experiments conducted with the assistance of Professor



DIRECTIONS TAKEN BY LOCOMOTIVE SMOKE

Dalby showed, he said, that very unexpectedly the smoke in an ordinary engine travelling at 50 miles an hour passed at first forward and was then bent backwards and downwards on to the boiler in the neighbourhood of the dome until it encountered the cab. The design of the front end of engine "No. 10,000" was such as to prevent the formation of a vacuum or region of reduced pressure in front of the chimney. As a consequence, the smoke rose straight upwards from the chimney and was bent back well above the top of the cab. These results were obtained by means of models in a wind tunnel, the smoke being represented by a stream of powdered chalk projected up the chimney. That the course taken by the smoke in the actual engine was that shown by the model was confirmed by a photograph which Mr. Gresley exhibited as a lantern slide. This photograph, reproduced herewith, shows engine "No. 10,000" travelling at high speed and leaves no doubt as to the manner in which the smoke passes away without obstructing the driver's vision.



THE YARROW-GRESLEY HIGH-PRESSURE LOCOMOTIVE, No. 10,000

Mr. N. H. Scarth, of Messrs. Yarrow, opened the discussion. He thought that Mr. Gresley's engine, quite apart from any question of fuel economy, would show a bigger reduction in the equally important maintenance and renewal costs than any of the other engines described in the paper. Between them Mr. Gresley and Mr. Yarrow had evolved a boiler having pronounced simplicity as regarded its pressure parts and its auxiliaries. The boiler, of necessity, departed to some extent from the usual Yarrow form, but an outstanding feature of the Yarrow type had been retained in the small number of riveted or bolted joints employed. The tubes, he continued, could all be inspected internally by removing one manhole door from the saturated steam drum, and were readily accessible externally from the fire-box or smoke-box. In addition, ashes and flue dust could be easily removed. These features were important in any water-tube boiler, and perhaps even more important in a locomotive boiler than in a marine boiler. It was gratifying to learn that no troubles, such as leaky tubes, had been experienced, as some people might have anticipated would have arisen from the severity of railway service. That result would, he thought, encourage Mr. Gresley to consider still higher working pressures for future locomotives. Mr. Gresley had stated that, although the working pressure had been greatly increased, the cost of the water-tube boiler in "No. 10,000" would not differ substantially from that of an ordinary wide fire-box type of boiler. He would add that, if an appreciable demand arose, the cost of water-tube boilers for locomotives would in all probability be still further reduced. The increasing use of high-pressure boilers in the merchant marine had, for example, enabled steel makers to offer seamless forged drums at considerably cheaper rates than those which ruled a few years ago. He had attended some of the trials of the engine and had been greatly impressed with its steady running. At all speeds vibration and rolling were almost completely absent. The rolling was, in fact, much less than that felt in the corridor of a passenger coach. It was of interest to note that the American Locomotive Company, the builders in 1924 of the Delaware and Hudson Railway's high-pressure engine, consulted Messrs. Yarrow in connection with the design of the boiler for that engine.

Herr Wempe stated that the Loeffler locomotive was not running now. Some trials had been carried out with it, but the results had not been given. The Winterthur engine was of small size. It had recently been fitted with additional tubes in the fire-box. The Schmidt-Henschel locomotive was now five years old. It was still in service and was giving very satisfactory results as regarded both fuel economy and maintenance costs. It showed, he said, a saving of 20 per cent. in fuel, as compared with the newest ordinary type of locomotive of the Reichsbahn.

Messieurs Haffner and Roger briefly referred to the working of the Schmidt-Henschel locomotive recently acquired by the P.L.M. Railway of France. This engine has been in service for about three months, and both speakers agreed that it had given satisfactory results.

Sir Henry Fowler expressed his indebtedness to Mr. Gresley, not only for undertaking the construction of a novel design of high-pressure locomotive in this country, but for his action in putting his experience with it at the disposal of the members at the earliest possible opportunity. He had not had an opportunity for a run in "No. 10,000," but he had had trips on the American engine "James Archibald" and on the P.L.M. Company's Schmidt-Henschel engine. He had been particularly impressed with the ease with which the American engine took heavy loads up steep gradients and with its low fuel consumption. There was little in Mr. Gresley's paper that was open to criticism. He hoped that at a later date figures for the coal consumption and the cost of maintenance would be published. The simplicity of Mr. Gresley's design as compared with, say, that of the Loeffler engine was very noticeable, but he expressed some doubt as to whether Mr. Gresley's system would overcome the difficulties introduced by the existence of permanent hardness in the water. It was easy, he said, to get rid of the temporary hardness constituents, but those responsible for the permanent hardness were much more difficult to deal with. Permanent hardness might cause the deposition of a porcelain-like scale, which might ultimately give trouble. What, he added in conclusion, was the weight of the boiler in "No. 10,000"? Was he right in assuming that it was no greater than that of an ordinary boiler of the same power?

Sir John E. Thornycroft raised a question as to the satisfactory nature of the circulation in the fire-box tubes of Mr. Gresley's engine when the locomotive was worked hard. It would seem difficult, he said, to realise in those conditions a proper downcoming action when there were only three rows of tubes in the fire-box walls. If trouble occurred from the deposition of scale in the fire-box tubes the simplicity of the design would no doubt make it easy to clean them at frequent intervals. In that respect Mr. Gresley's engine would show to advantage over the continental engines, in the design of which considerable complexity was introduced for the sake of keeping hard water out of the fire-box tubes.

Mr. R. E. L. Maunsell remarked that the use of high-pressure steam in locomotives was a subject of great attraction to scientists. The outward appearance of Mr. Gresley's engine would no doubt be of much interest to admirers of Epstein. But to the locomotive engineer the principal question of importance was the economy of the high-pressure engine. No figures had as yet been published in that connection concerning the L.N.E.R. engine, and it was difficult to obtain trustworthy figures for the other locomotives mentioned by Mr. Gresley. Dealing with the discharge of the smoke from the chimney, he said that trouble had also been caused by it on the Southern Railway. Many devices for its cure had been tried, but none had proved successful except the fitting of "blinker plates" on the sides of the smoke-boxes. Those plates had proved distinctly effective.

Mr. Charles Eley expressed the opinion that Mr. Gresley's engine represented a gratifying co-operation between the mechanical and the marine engineer, and suggested that, as an additional step in advance, the possibility of fitting surface condensers on locomotives should be studied.

Mr. W. A. Stanier said that since the days of the Brotan fire-box locomotive engineers had desired to use water-tube fire-boxes. Mr. Gresley had shown them how to use, not only water-tube fire-boxes, but water-tube boilers. The boiler of "No. 10,000" seemed to be a sound mechanical job, but he wondered whether the outer rows of the fire-box tubes received a proper proportion of the radiant heat. He also desired to know whether any particular difficulties had been experienced with the lubrication of the engine. Mr. Gresley had stated that the engine as originally built had been fitted with two high-pressure cylinders, 12in. in diameter, and two 20in. low-pressure cylinders, but that by reducing the high-pressure cylinders to 10in. a more equal distribution of work had been obtained. Mr. Stanier asked whether, as an alternative to reducing the high-pressure cylinder diameter, the reduction of the low-pressure cylinders to 18in. and an alteration in the cut-off had been considered.

Lt.-Col. E. Kitson Clark, discussing the design of "No. 10,000," called attention to the remarkable manner in which the problem of weight distribution had been solved by placing the trailing bogie beneath the fire-box. With small cylinders and high pressures the area of the piston-rod was responsible for a considerable reduction in the total force on one side of the piston, and to compensate for it a tail rod was usually fitted to the opposite side of the piston. Did Mr. Gresley use such tail rods in his high-pressure cylinders? Concerning the change that had been made in the diameter of the high-pressure cylinders, he said that, as originally designed, the high-pressure cylinders were to him obviously too big for the low-pressure cylinders. The method of independently varying the cut-offs in the high and low-pressure cylinders greatly interested him. In normal running the cut-offs that Mr. Gresley had found best were 50 per cent. in the high-pressure and 25 per cent. in the low-pressure cylinders. That result was not in accordance with the conclusions reached by certain railway engineers in South America, who, because of the long runs and the high cost of coal, had been led to make a very close study of the subject.

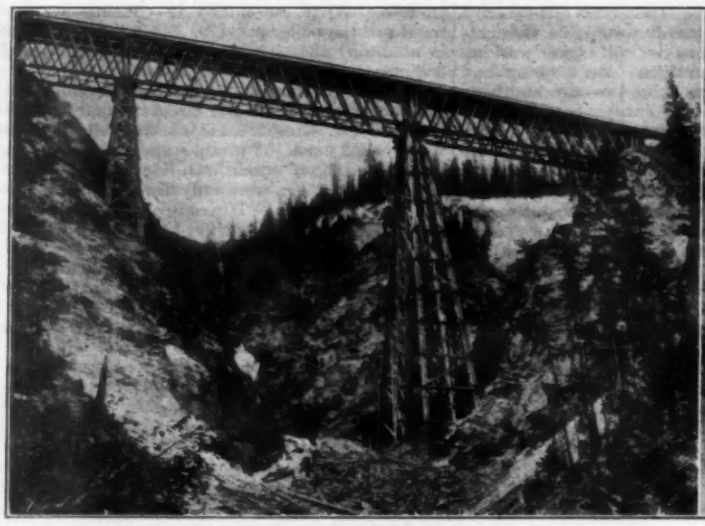
The discussion at this stage was adjourned until February 6th.

Reinforcement of Stoney Creek Bridge.

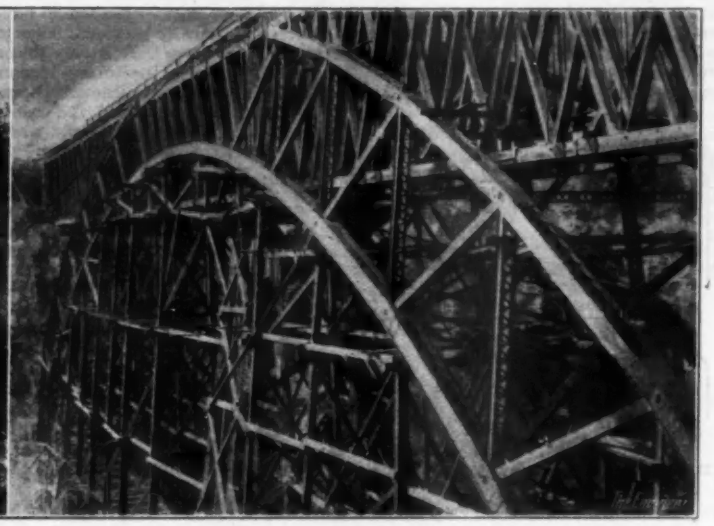
A VERY important piece of bridge engineering was recently described in a paper presented by P. B. Motley, engineer of bridges, Canadian Pacific Railway, before the Montreal branch of the Engineering Institute of Canada, and later published in the Institute's own periodical, the *Engineering Journal*. The paper deals with the reinforcement of the Stoney Creek arch bridge in the Canadian Rockies.

The Stoney Creek bridge is situated on the line of the Canadian Pacific Railway on the eastern slope of the Selkirk range at a point immediately east of the

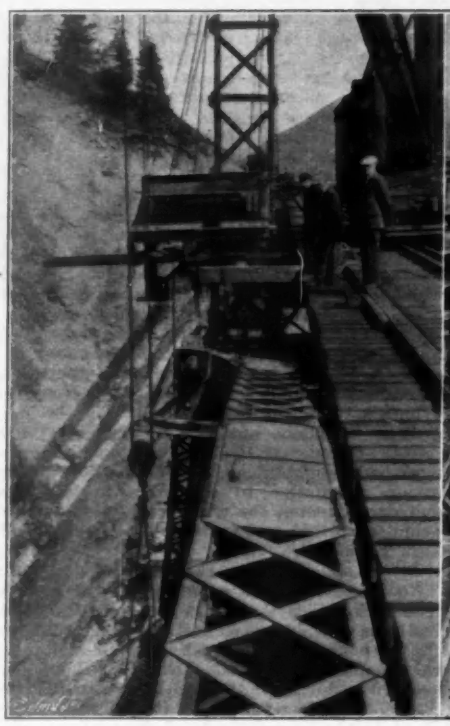
CANADIAN PACIFIC RAILWAY—BRIDGES OVER STONEY CREEK



THE ORIGINAL WOODEN BRIDGE OF 1896



ERECTING THE 1893 ARCH BRIDGE

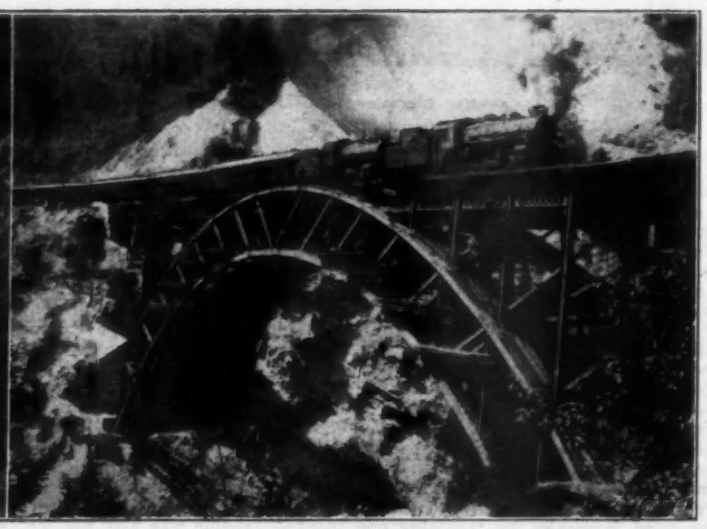


ERECTING THE OUTER REINFORCING ARCH—1929

THE COMPLETE 1893 ARCH BRIDGE

ERECTING NEW TRACK SPANS—1929

CANTILEVER FALSE-WORK FOR PLACING REINFORCEMENT—1929



TEMPORARY LOADING OF NEW ARCH RIBS—1929

summit, where the famous Connaught Tunnel pierces the range, and about 428·5 miles from Vancouver. It consists of a 336ft. three-hinged arch, on which are supported plate girder track spans which are extended to the abutments at both ends, making a structure 486ft. long. There is a curve on the west approach to the bridge, but otherwise it is on tangent, and the distance from track level to the bottom of the gorge on the centre line of the bridge is 307ft.

It stands on what was originally that portion of the railway begun by the Dominion Government in British Columbia just before the inception of the Canadian Pacific Railway in 1887 or a little earlier. The first structure was a deck Howe truss bridge of two 200ft. spans and one 100ft. span—approximately—supported on two tall wooden towers, and, at that time, had the reputation of being the highest wooden structure in the world.

In 1893 it became necessary to renew the timber spans. That was during the chief engineership of P. A. Peterson, Past President of the Canadian Society of Civil Engineers, who entrusted H. E. Vautelet, M.E.I.C., then a company's assistant engineer, with the task of designing a bridge to replace the old structure. Mr. Vautelet decided upon a 336ft. double-chorded, three-hinged steel arch, the erection of which was started in the early summer of 1893, and the falsework was completely removed by July, 1894. The method of reconstruction was to fill the gorge with falsework, which was so designed that first the lower chord of the arch ribs could be erected upon it. Then the web members and upper chord of the arch ribs were erected seriatim. Having completed the two arch ribs and their sway bracing and laterals, the track was supported on the falsework by means of suitable pony bents arranged between the arch trusses and the track spans. The new steel track spans consisted of lattice girders ranging from 63ft. to 84ft. in length, supported on steel bents. These lattice girder spans were lowered into place by means of gantries and screws at one end, and a small double-boomed derrick car at the other. This work, with the removal of the interlaced timber work, was done between trains without disturbing traffic.

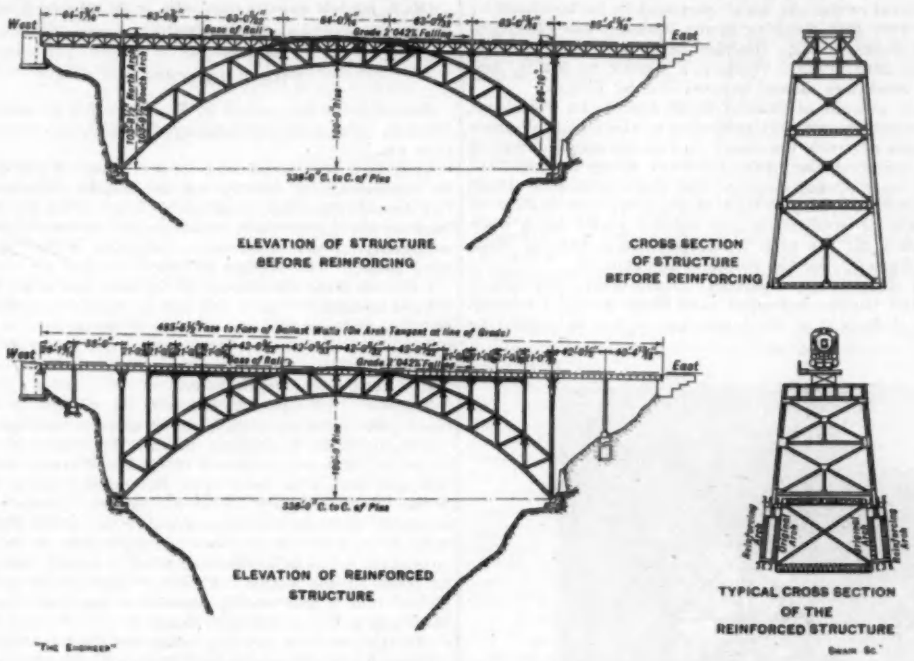
The contract for the manufacture and erection of this original arch bridge was entrusted to the Hamilton Bridge Company, of Hamilton, Ontario, which had at that time as its erection superintendent Mr. James Finley, who later achieved considerable reputation as an efficient and successful bridge erector, being responsible for a large number of the creditable pieces of construction in Canada in this branch of engineering during the last thirty years.

A derrick car having double booms was employed for lowering the floor beams framing into the bents carrying the track spans, and this double boom car was understood in 1893 to have been unusual in American bridge practice. It is interesting to note that it is still in service on the Canadian Pacific Railway at Revelstoke, British Columbia.

A deflection test was made on November 20th, 1893, of the steel structure after it had been swung clear of the falsework. In this test six locomotives of that period were used. They completely covered the 336ft. arch and weighed altogether some 550 tons. It may be mentioned that in a test which was made after the completion of the reinforcement, it was only possible to get four modern locomotives over the arch proper to fill the space which six locomotives occupied in 1893.

In comparison with contemporary arches, of which there were only a few in existence at that period, Mr. Vautelet's design evoked favourable comment. As far as is known, it was the only double parallel chorded railway arch in existence with its main hinge pins on its lower chord, in contradistinction to the taper-chorded arch in the Garabit Viaduct in France. It was, however, similar to the highway arch at Niagara, except that the latter has its pins placed midway between the chords.

The structure continued in service from its completion in 1893, accommodating heavier and heavier engines, and although, as a result, various members were overstressed, yet the limits of good practice in such matters were not exceeded. But in the summer of 1928 it was decided to increase the capacity of all the bridges on the mountain subdivision of the Canadian Pacific Railway between Field and Revelstoke, in order to accommodate new and heavier power.


West
East
Base of Rail
Grade 2·042% Falling
336'-0" C. to C. of Pins
ELEVATION OF STRUCTURE BEFORE REINFORCING
CROSS SECTION OF STRUCTURE BEFORE REINFORCING
485'-6½" Face to Face of Ballast Walls (On Arch Tangent at line of Grade)
ELEVATION OF REINFORCED STRUCTURE
TYPICAL CROSS SECTION OF THE REINFORCED STRUCTURE

DIAGRAMS SHOWING ARCH BRIDGE BEFORE AND AFTER REINFORCEMENT

Careful studies were made of these structures, some being reinforced and others completely renewed either in place or on new positions alongside.

At Stoney Creek, on account of the desire to avoid the various inconveniences and possible delays both to the bridge replacement and to traffic, the intention was to erect a new structure in a position about 40ft. north of the existing one, and to use a cantilever deck truss bridge supported on two new piers and abutments. The centre span of this cantilever bridge was to have been 311ft. with a 111ft. flanking span at either side. However, it was found that on the west side of the canyon a clay fault about 2ft. thick ran down the mountain side at such an angle as to come just under the proposed pier on that side of the opening, and exploratory borings showed that it was impossible to place the pier entirely clear of it. In addition to this the walls of the canyon, which are composed of soft schist with outcropping ledges of hard rock, afforded no better site for a pier than was occupied by the original bridge. After exhaustive exploration it was decided to abandon the plan of an independent bridge alongside the old and revert to the original site.

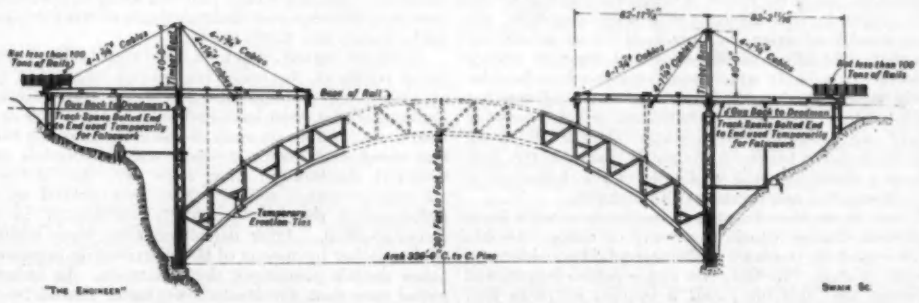
Cooper's E–60 was decided upon as the loading for the remodelled bridge, and a complete investigation was made of the old structure, using that loading. This investigation showed that it was entirely feasible to erect new arch ribs outside the existing ribs, and attach them together in place in such a manner as would equally distribute the new live load between the old and the new ribs. This was accomplished by the use of equalising beams, on top of which are built up the bents carrying the track spans above. In the original bridge the track spans were of such length as to give concentrated loads upon the arch at every third panel, except in the centre of the bridge. It was found economical to shorten the track spans to one panel each, except in the centre of the bridge where this was impracticable, and two panel spans were used. In addition to this, the calculations showed that in the original arch structure the new scheme of loading required some reinforcement in certain members, and this was done.

The resulting structure, therefore, consists of four arch ribs, attached to one another in pairs by equalising diaphragms, and of a system of bents so placed over the diaphragms that the arch ribs all share the loads equally. There is an exception to this statement in connection with the bents over the end pins. On account of the fact that these are considerably eased of their loading by the shortening of the adjoining spans, it was decided for practical reasons to leave these old bents untouched. They are, therefore, slightly out of line as regards the other new bents, but on account of the extra hazard in handling them during erection and the extreme difficulty in avoiding interference with traffic, it was found later that this decision was justified.

There were no serious difficulties in manufacture, the drawings of the old arch ribs being followed closely in the fabricating new parts and the sections and material were, as far as possible, made identical, both as to dimensions and physical characteristics, so as to ensure uniform stiffness in both old and new ribs. The same system of double-flanged thimbles and pins was used as in the old structure. This feature deserves some description, as it formed an important detail in Mr. Vautelet's original design. In the old structure the lower chord was first erected with thimbles upon a bed of falsework and without, in the first case, a single pin being used. These thimbles were 12in. in diameter and provided generous bearing surfaces between chord sections. On the finished lower chord were erected the web members and top chords pinned together at all intersections with pins passing through the thimbles, or members, as the case might be, the large main pins of the structure, namely, the skew-backs and centre of span, forming the hinges or turning points of the arch. The wisdom of this arrangement will be apparent, since the thimbles allowed the original lower chord to be erected and swung clear of the falsework, if necessary. the pins later taking care of the web members and upper chord.

On these completed arch ribs, after transverse and lateral bracing had been put in, the vertical bents were erected. They were provided with disc bearings at their lower ends and pin bearings at the upper, where the track spans rested. The function of these articulated bearings was not actually to rotate in service, but to provide good bearing and adjustment to the grade which exists on the bridge, besides tying the track spans together longitudinally. This disc bearing has been used extensively since the construction of the original bridge in Canadian Pacific bridge practice.

Broadly speaking, the track spans on the old arch bridge delivered their reactions at six points on the old arch, including the haunches. In the reconstructed bridge the arch has the reactions delivered to it at thirteen points, and the flanking spans have been approximately bisected by new bents arranged on new substructures provided for the purpose. Thus the structure has been improved, both æsthetically and theoretically, and, while it appears to be broad enough for double-track service, this is not a disadvantage, in that it makes for lateral stiffness in service on account of the broad base provided by the widened haunches.


Not less than 100 Tons of Rails
Base of Rail
Temporary Erection Ties
307 Feet to Foot of Bracket
Arch 336'-6" C. to C. Pins
"THE ENGINEER"

SCHEME FOR ERECTING NEW ARCH RIBS BY CANTILEVER TRUSSES

The new vertical bents are attached to the loading beams midway between the arch ribs. In the central portion of the arch, however, where no equalising beams or bents were necessary, new long double floor beams are provided. They run through the structure, and are riveted to both old and new trusses, thus combining floor beams with loading beams.

The track spans themselves are generally equal to the length of a panel, namely 21ft., except those coming in the centre of the bridge, where they are 42ft. long. They are all provided with articulated key bearings at their ends so as to deliver their reactions over the webs of the double floor beams. In order to provide a continuous tie between the track spans longitudinally, it was felt advisable to put a link and pin connection between the ends of all track spans. The tensile forces in the new structure are transmitted through lattice struts to the arch ribs themselves.

Having been driven to reinforcing the bridge in place on the main line of a very busy section of the railway, on which sometimes fifteen passenger trains had to be taken care of during the hours of daylight, naturally the problem of reconstruction resolved itself largely into one of erection methods. It was not allowable to utilise the old structure for any erection loads, and it was therefore incumbent upon the engineers so to design the work that the arches could be erected by means entirely self-contained and self-supporting.

The scheme decided upon and carried out consisted in the use of a pair of cantilever trusses, counterweighted with old rails at their shore ends, including a wooden tower carried up from a convenient point on the skew-back substructure to such a height as to reduce the stresses to convenient limits. The upper chords of these cantilevers consisted of cables, and for the lower chord a series of the new track spans, complete with laterals and brace frames, were bolted together end to end. These were placed just above the base of rail and at first extended only three panels out from the skew-back panel points. From these plate girder lower chords the panels of the new outer arch truss or rib were suspended by means of suitable wire cables, building out panel by panel, until finally the lower chords and their suspenders had been extended to four panels. There was no further extension from this point, and, instead, the arch ribs of the remaining four panels were cantilevered out from each side of the canyon until they met in the centre. It will thus be seen that each of the arch ribs was built out in a self-supporting manner, except for a system of short temporary horizontal struts from the old arch ribs, but otherwise entirely independent of it as far as loading was concerned.

REINFORCED ARCH BRIDGE UNDERGOING TEST

The arch ribs having been thus completed, the work of fastening them together by means of diaphragms or equalising beams was begun. Before doing this, however, a system of brackets was erected outside the arch ribs at each vertical. On these brackets was supported, panel by panel, a temporary group of old rails, carefully calculated to provide precisely the same dead load upon the new arch rib as existed on the old. The effect of this was that the new arches deflected to a point which was considered to be relatively equal to the dead load deflection of the old arches, thus producing conditions which were as nearly as possible theoretically similar in both. Elevations were taken on the panel points of the arch ribs as a check, and the similarity of the deflection of the old and the new work was remarkable.

There is another feature in connection with these falsework trusses which is worthy of note. As was to be expected, the wire cables stretched considerably during loading. In fact, the upper cables lengthened between 6in. and 9in., and a system of jacks and jacking beams, which operated very satisfactorily, was provided for adjusting them.

After the arch ribs were coupled up on one side of the bridge, the falsework cantilevers were taken down and re-erected on the other side of the bridge and the same procedure followed in erecting the second arch rib. Progress in the various stages of the work was extremely rapid. There were always two gangs working on each portion of the work, one from the east and the other from the west end. The north arch, which was first erected, took fourteen days to couple, and the south one twelve days, and all this in the face of the heavy traffic before referred to. In order to avoid the worst of the traffic the erection crews started work at five in the morning, and it was possible to have a somewhat free space of time until about 10 a.m., when the usual rush of traffic for the day began and continued until five in the evening.

The portion of the work which presented the most difficult problems and needed the most careful preparation commenced after the new arch ribs were erected and the sway and lateral bracing had been reinforced, or renewed, as required. By the plans the problem resolved itself into a series of operations in which the track was opened, old track spans and bents removed, and new bents and track spans placed. Starting at the east, or down-grade end, after the old wooden deck had been removed, the first 84ft. lattice span was cut apart as to its laterals and brace frames and the two lattice trusses separated to such an extent as to be completely clear of the new work. At the east abutment this necessitated a small amount of temporary cribbing upon which the trusses could rest until, at a more convenient time, they could be entirely removed to the land. The operation of splitting this span made a gap in the work wide enough to enable two single-boom derrick cars to place the first two 42ft. flanking spans at the east end, the first land bent having been placed previously. This operation, with the opening and the closing of the track, the removal of the old 84ft. span and its replacement by the two 42ft. flanking spans, opening and closing of the tracks, placing the ties, rails, &c., took place on June 26th, 1929. Work was started at 5 a.m. and the track was cleared in good time by 10 a.m.

An account of these difficult operations would not be complete without reference to the fact that seven breaks of track necessary to the operation involved the removal and transportation along the track of old truss spans, some of the single pieces of which weighed 20 tons. Had there been any failure of tackle or equipment the results would have been serious, for the arch trusses and their bracing, and, incidentally, for the traffic of the railway.

A deformation diagram—under dead load only—of the trusses indicated that there should be about ⅛in. deflection at the centre pin. That is to say, the unloaded new arch trusses should have been relatively ⅛in. higher at their centres than the old trusses when first erected, without the dead load which should come on them by reason of the track spans, bents and other attachments. This was realised almost to a fraction by the accuracy of the lay-out of the skew-backs. It is hardly necessary to point out that it was extremely difficult to lay out this work and to attain precisely the required distance back to back of skew-backs across this 336ft. air line.

As before stated, brackets were attached to certain panel points of the outer trusses, on which 115 tons of rails were distributed, this being the estimated amount of the dead load included in the track span, bents, &c., falling on each of the arch trusses. When this dead load was put upon the new arches they behaved identically; that is to say, they deflected an equal amount, namely, ⅛in., as expected by the deformation diagram originally calculated in the drawing-office. After deflecting they were securely tied together by means of the distributing beams and other details previously decided upon. In order to make sure that the loads were being shared by the trusses as expected, a final test was made of the bridge on August 21st, 1929, using four of the heaviest engines available.

The four engines just about covered the 336ft. arch span, with a slight overlap, and the observed maximum deflections in the centre of the arch were about 1⅛in. While the deflection of the new north arch rib was slightly less, those of the other three were reasonably uniform. It is a fact, however, that the unreinforced arch under ordinary traffic, which was usually composed of double-headed engines weighing 230 tons each at a customary speed of 10–15 miles per hour, deflected 2⅛in., whereas after the reinforcement of the structure the deflection under a standing load of four engines was only 1⅛in. It is also interesting to note that the aggregate weight of four engines used in the test load of 1929 was almost exactly double that of six engines in 1893.

The field work was begun in April, 1929, and completed in August, thus occupying less than five months. The contract for the manufacture and erection of the reinforcing arch ribs, new bracing, and new track spans was entrusted to the Canadian Bridge Company, of Walkerville, Ontario, Mr. F. W. Parr being in immediate charge of the work in the field under Mr. Charles Prettie, superintendent of erection for the Bridge Company, and E. Chorolsky, S.E.I.C., as field engineer. For the railway company, J. M. R. Fairbairn, M.E.I.C., chief engineer, was responsible for the work as a whole.

The scheme of reinforcing the structure in the manner described was developed and designed in the bridge department of the railway company, under the supervision of Mr. Motley, with A. R. Ketterson, A.M.E.I.C., assistant engineer of bridges, in direct charge.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE "ROCKETS."

SIR,—One or two points in Mr. Holcroft's interesting letter in your issue for January 23rd call for remarks from me.

First, he must not claim me for a convert. I will take an opportunity of looking up the *English Mechanic*; but the correspondents quoted in his letter of the previous week do not inspire much confidence, on account of their anonymity. I have little faith in witnesses of the "Constant Reader" or "Mother of Twelve" order.

I do not place the original of the sketches *before* the "Northumbrian." All I can say is that it was about contemporaneous, *if* it was a different engine.

I see that the *English Mechanic* people knew of the Nasmyth sketch, so they lose the support they would have had if testifying independently.

The worst difficulty Mr. Holcroft has to meet—I had nearly said fatal objection—is that there is no trace of the engine in the Stephenson records. The entries in the ledger of 1823–1831, referred to by Mr. Warren, which was not discovered until after the publication of my "Two Essays in Early Locomotive History," agree with it exactly, with the exception of one or two trivial alterations in the order of the dates of completion. If we are to take the ledger as constituting a list of engines, there is no room for the second "Rocket." But it may be, of course, that it was omitted because it was unsold, and there was no one to whom to charge it.

Mr. Holcroft's list certainly establishes the fact that the "Comet" was originally called "Rocket." This, however, carries very little weight in itself, since the next three names were also used for L. and M. engines.

I append a reproduction of Deghilage's illustration. It

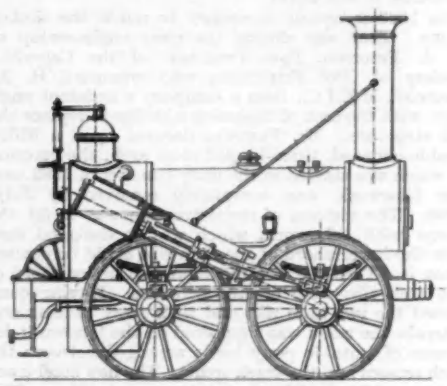


Fig. 4

1832. — "La Fusée" par Stephenson (Chemin de Liverpool-Manchester) Transformation

"THE ENGINEER" SWAN Sc.

is nowhere suggested that he ever saw the engine, as Mr. Holcroft has inferred. My translation of his words is "Drawing reproduced from a sketch made (?) in March, 1832, by Mr. Stenson, of Leicester, on the Fosse Lane siding." But I am not quite sure of the meaning of *relevé* in this connection. It rather suggests "restored."

The name Stenson is evidently correct. Deghilage had no inkling of the ghost story. He thought it was the first "Rocket" transformed.

As to the form of the L. and S. "Comet," Mr. Warren—who perhaps will speak for himself—in "A Century of Locomotive Building," gives a drawing of an 0-4-2 engine with inside cylinders—agreeing with Stretton—entitled "Proposed Locomotive Engine for the Stanhope Railway," and says: "But it appears from the makers' records that the first engine built with the wheel arrangement shown was transferred to the Leicester and Swannington Railway."

The late Dr. Glaisher had an earthenware plate in his collection on which the opening of this railway is depicted. I am endeavouring to obtain a photograph of it.

C. F. DENDY MARSHALL.

Guildford, January 24th.

SIR,—I note that a new controversy has arisen with regard to the "Rocket" locomotive.

I well remember the discussion which took place nearly half a century ago. At that time, although men were still alive who had seen the "Rocket" at Kirkhouse under my

grandfather, it was impossible to feel quite confident that one had discovered the truth, the whole truth, and nothing but the truth. To-day, when the older generation has long since passed away, I feel even less sanguine about reaching finality. I shall, however, read with much interest any conclusions to which your correspondents feel themselves justified in coming.

It is curious how easily confusion slips into railway history. I happened to be at Carlisle on the afternoon of January 3rd, when a Waverley route passenger train from Edinburgh was derailed. The train was drawn by an engine of the "Shire" class, but one of the papers informed its readers that the engine was one of the "County" class. Of course, in everyday life a Shire and a County are for all practical purposes the same thing; but if a hundred years hence there is anyone left who takes an interest in the steam locomotive, correspondents in THE ENGINEER will be trying to solve the mystery how on this occasion a Great Western engine came to be working on the North British line. Thus is history written.

London, January 27th. W. B. THOMPSON.

OIL ENGINE NOMENCLATURE.

SIR,—Regarding the editorial paragraphs on oil engine terminology in your issue of December 19th, it is a little disappointing to learn that one with the trained imagination and vision of Dr. Pye has contributed to the need for such editorial comment.

For some time the writer has believed that no commercial engine should bear any individual's name in order to designate type. Tradition, or something else, causes us to cling to certain specific qualities or characteristics as belonging with a man's name. But commercial engines are ever-changing creations. We need therefore direct, descriptive names readily changeable.

Furthermore, no sales agents—and these fellows are too often one of the drags on engine development, as on much of our "prosperity" under industrial Bourbon direction—could, for example, get away with calling an A.C. motor a D.C. motor as easily as they could misapply the inventor's names. It might not, of course, take much mental effort to check up on a salesman's statement, but, as Edison says, there is no effort mankind will not make in order to escape the effort of thinking.

A possible plea that such procedure as mentioned above would deprive discoverers and inventors of incentive and fame would be just Barnum stuff. The possessor of a creative mind *needs* money—money both to live on and to further his ideas to where they have for him market value.

Regarding support, fame, and paths to engineering glory, the only difference between the historic manner in which inventors have been treated, is that the British, for example, compelled Watt to waste his time at surveying in order to provide for his family, and the Germans provided conditions that led Dr. Diesel to go drown himself. So much for engineering fame.

As regards the issues of the compression-ignited engine of size for automotive and aeronautic service, and after making some allowance for the different fuel situations in America, and in Europe, new conceptions affecting engine classification are desirable. In much of the automotive and aeronautic fields a fuel price below that now existing for fuel for carburetter engines is not a primary issue. Why, then, the effort and expenditure to provide the carburetter engine with a refined anti-knock fuel, and ask engineers to operate a more efficient engine on a less refined fuel, relatively a residue?

We provide a special fuel in order to benefit the smoothness and efficiency of a spark-ignited engine, yet we give the high-speed compression-ignited engine a fuel that is a definite handicap in its competition with the spark-ignited engine on B.M.E.P. and r.p.m. Meanwhile the engine having thermo-dynamically the better references, is relegated to the truck engine field. Evidently, the Bourbon mind permeates all fields of industry.

Let those who wish to play with "full Diesels," Diesels, "semi-Diesels," and other back-to-grandmother styles, continue to do so. But let some of us get at least one leg over the stone wall of financier domination, and give the new baby a new name, and let it develop according to the conditions of its own era. Why try inside a small chamber which our vision can as yet only indirectly penetrate, to deal mechanically with the behaviour of a fuel—drop by drop—when a chemist can deal with it, predigest it if necessary—not by the drop, but by the hundreds of gallons?

ROBERTSON MATTHEWS.

Detroit, January 14th.

FRENCH RAILWAYS AND ELECTRIFICATION.

SIR,—The "French Engineering Notes" in your issue of January 9th contain a paragraph on the subject of the P.L.M. electrification between Chambéry and Modane, from the concluding sentence of which one would infer that this electrification is novel in France, both in the use of a 1500-volt D.C. supply and also in the use of a third rail. The real novelty, however, lies in the combination of these two, as it has usually been considered necessary for the safety of track *personnel* to use an overhead contact line for this voltage.

The conductor rail is guarded continuously in the present case, and is a top contact rail, but the locomotives are fitted with pantographs in addition to collector shoes, so that overhead conductors can be used if necessary in any section.

D.C. supply at 1500 volts is the standardised supply for all main line electrification in France, as on the P.L.M., Paris–Orleans, and Midi railways, with 3000 volts D.C. as a possible alternative in exceptional cases. The P.O. and Midi electrifications, which are much more extensive than the P.L.M., are 1500-volt overhead contact systems throughout, catenary suspension.

On the other hand, the electrified Paris suburban section of the State Railway is carried out at 650 volts D.C., and employs an under contact conductor rail.

Harrow, January 21st. A. LISLE.

The Meopham Aeroplane Disaster.

THE following extracts are taken from the report on the Meopham aeroplane disaster, which was issued by the Air Ministry at the end of last week. The report, price 5s. 6d., is obtainable through any of the branches of H.M. Stationery Office.

SUMMARY.

(*a*) The accident happened at Meopham, Kent, on July 21st, 1930, at 14.35 hours.

(*b*) The aeroplane G-AAZK, a low-wing monoplane, constructed by the Junkers Works, Dessau, early in 1930, and not dismantled after it left Germany, was seen by persons at work near Meopham to enter a cloud; almost immediately a loud noise was heard and fragments of the aircraft were observed falling from the cloud. The passengers and crew were killed. After the usual investigation by the Inspector of Accidents, Air Ministry, and after the inquest, the Inspector reported that—

> "with the evidence available I have been unable to arrive at a definite conclusion as to the cause of the accident."

(*c*) The matter was referred on August 25th to the Aeronautical Research Committee for investigation. The Accidents Investigation Sub-committee met on September 3rd, and since that date have held 21 meetings. An Interim Report was published in the Press on November 4th.

(*d*) An early act of the Sub-committee was to communicate through the Air Ministry with the representatives of the occupants of the aeroplane, explaining the technical nature of the inquiry they were about to make and inviting all technical evidence. This inquiry has been one of the most difficult which the Sub-committee have been called upon to investigate during the past fourteen years.

(*e*) It was stated in the Interim Report that—

> "careful examination of all main fractures has revealed no defect in structure or assembly. Further, there are no signs of faulty or inferior material in the fractures,"

and this has since been confirmed.

(*f*) One obvious simple cause of the disaster has been suggested. The aeroplane, flying at a high speed, may have been broken by a too violent use of the controls, and this was the first suggestion to be closely examined. It is known that any commercial aeroplane, if allowed to reach a sufficiently high speed, can be broken in the air by misuse of the controls. Detailed investigations into the strength of this aeroplane have, however, shown the Sub-committee that in the case of a too sudden flattening out of the flight path the wings must have broken before the tail. It is highly improbable that an undamaged tail could have been wrenched from the fuselage in the air after one wing had gone. Moreover, in many years' experience of accidents in England in which aeroplanes have broken in the air, the Sub-committee have found that the tail has either broken first, or that it has come down intact with the main structure.

(*g*) The Sub-committee conclude that a too violent use of the controls would not provide a satisfactory explanation of the primary cause of the accident, and that there is no foundation for a number of sensational suggestions.

(*h*) In the Interim Report reference was made to experiments on flutter on a model of the aeroplane which were in hand at the National Physical Laboratory. These proved that tail flutter did not occur within the speed range of the aeroplane; it would develop only at speeds above 250 miles per hour.

(*i*) There is, however, another possible cause of tail oscillation, provisionally called "buffeting," which is known to occur at incidences near the stalling attitude. Experiments, just completed at the National Physical Laboratory, on the model made for the investigation of flutter, have shown that mild "buffeting," similar to that observed on the full-scale aeroplane, occurs at attitudes of the aeroplane corresponding with slow speed flight near the stalling speed. At higher speeds in the same attitude the "buffeting" increased and attained a violence which, in the case of a full-scale aeroplane, would have broken the tail at speeds less than the cruising speed.

(*j*) The term "buffeting" is here used to denote an irregular oscillation of the tail unit, in which the tailplane bends rapidly up and down and the elevators move in an erratic manner. It is a phenomenon distinct from that known as "flutter."

(*k*) "Buffeting" is due to eddies from the main planes and is known to occur on some low-wing monoplanes when the aircraft approaches the stalling attitude. Notification has been received by the Aeronautical Research Committee that this phenomenon has been experienced on more than one type of aeroplane in this country, especially just prior to landing; but it has not hitherto been systematically investigated.

(*l*) The evidence of pilots passing over Meopham about the time of the accident indicates that the air in this locality was very bumpy and the flight conditions were difficult. In the cloud, due to up-currents and to turbulence, the attitude of the aeroplane could temporarily have become such that violent buffeting set in; the tailplane could have been thereby broken and the other breakages follow.

(*m*) In the opinion of the Sub-committee this is the most probable primary cause of the disaster.

(*n*) The Sub-committee recommend:

(i.) That the phenomenon described as "buffeting" should be investigated.

(ii.) That steps should be taken to place the measurement of turbulence in the air, described generally by pilots as "bumpiness," on a definite scientific basis by the carrying of accelerometers on aircraft, or by other means. Such measurements will help to define the size, distribution and sharpness of the boundaries of up and down currents. The knowledge is needed to determine the load factors to which aeroplanes should be designed.

(iii.) That the removal of parts from wrecked aircraft by souvenir hunters should be discouraged in every way possible, and that the public be informed that damage resulting in this way may destroy valuable evidence that might help in making aircraft safer.

THEORIES OF THE ACCIDENT.

Critical Examination of Various Theories.—Plausible explanations of the accident, which can be dismissed briefly, are summarised as follows:—

(*a*) That the engine cowling became unfastened, blew back and obscured the pilot's view. (Disproved by evidence.)

(*b*) That an airscrew blade broke or was damaged in the air, to result in an unbalanced force being applied to the aeroplane sufficient to tear the engine from its mounting. (Disproved by evidence.)

(*c*) That the wooden bearers under the engine failed first. (Disproved by evidence.)

(*d*) That there were defects in material. (Disproved by examination of structure.)

(*e*) That there was incorrect assembly. (Disproved.)

(*f*) That the wings had been removed for examination in England and incorrectly assembled. (Wings not removed.)

(*g*) That the aeroplane was damaged while it was pegged down in the open at Berck. (There is no evidence of weakening of the fuselage or tail skid prior to the accident.)

(*h*) That an explosion occurred in the aircraft due to ignition of petrol vapour or other cause. (There were [i.] no signs of burning or singeing; [ii.] no interpenetration of parts of the structure, and [iii.] no series of breakages radiating from a centre.)

PROBABLE PRIMARY CAUSE OF THE ACCIDENT.

The experiments at the National Physical Laboratory have emphasised the possibility of tail buffeting being an important factor in the causation of the accident. The experiments have shown that the buffeting of the tail of the model of G-AAZK occurs at angles of incidence near to the stalling and that the violence of the oscillations increases with the air speed. Under corresponding conditions on full-scale the amplitude of the oscillations would become so large as to break the tailplane at speeds within the normal flying range of the aeroplane. The mean forces thus produced would tend to produce an upward fracture such as that observed.

Although the combination of high speed and high angle of incidence can only occur in flight temporarily, and although they cannot both be maintained for many seconds at a time, the experiments have shown that large deflections can occur in a very short time.

It follows from the evidence of pilots passing over Meopham about the time of the accident that the air in this locality was very bumpy and the flight conditions were difficult. It is possible that in the cloud, due to up-currents and to turbulence, the attitude of the aeroplane became such that violent buffeting set in; the tailplane was thereby broken and the other breakages resulted.

The suggested sequence of events is as follows:—

The port tailplane extension broke upwards as a result of buffeting, consequent on high incidence produced by air bumps, and folded backwards on to the port elevator. The elevators were forced down and, in spite of any efforts by the pilot, the aeroplane dived sufficiently to reach a speed in excess of the 135 miles per hour, below which the wings of this aeroplane cannot be broken. The damaged port tailplane extension produced failures in the elevator and both parts broke away from the aeroplane and fell considerably to the East of the main masses of wreckage.

The tail unit, now damaged and bent, would probably flutter. This would give rise to large forces and thus bring about the separation of the tail and the fuselage. On the other hand, it might have been twisted off, due to previous damage at a relatively late stage during the final dive. The aeroplane, moving at a high speed, must have reached a stalling attitude, thus stressing the wing structure beyond its breaking limit and fracture occurred.

According to the evidence, the steps by which the engine was torn from the aeroplane would need a somewhat greater acceleration than that required to fracture the wing, and it is difficult to see how this could have been produced after the wing had broken. The circumstances of the accident make it clear that the aeroplane was subjected to a rapid angular acceleration, tending to raise the nose, the effect of which, superposed on that due to the forces on the wings, might have been sufficient to break the engine supports. These considerations will not, however, affect the conclusions of the Sub-committee as to the probable primary cause of the accident.

In putting forward buffeting as this primary cause, the Sub-committee have taken into consideration the fact that no previous accident has been attributed to this cause. In spite of this they are unanimously of the opinion that this explanation is the only one yet put forward which is consistent with the evidence.

AFTER weeks of careful preparation, workmen have succeeded in raising the 300ft. span of the Second Narrows bridge, Vancouver, which was forced into the channel when the "Pacific Gatherer" collided with the bridge on September 19th. Five scows were used to bring the steel structure to the surface, after which it was beached on the flats west of Lynn Creek with the aid of three tugs, and eventually conveyed to the dock for inspection and repairs.

Obituary.

ANDREW LAING.

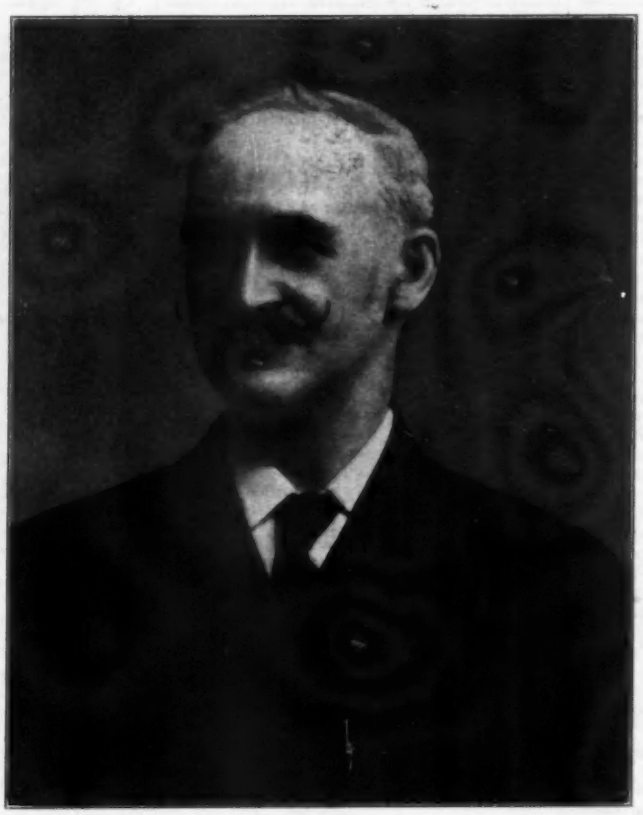
THE marine engineering profession has suffered a very severe loss in the death of Mr. Andrew Laing, the managing director of the Wallsend Slipway and Engineering Company, Ltd., of Wallsend-on-Tyne. Mr. Laing was in London about a week before his death and attended to business matters with his wonted zest and interest. He caught a chill, double pneumonia supervened, and he died at his home, 15, Osborne-road, Newcastle-upon-Tyne, on Saturday afternoon last, January 24th. Despite his seventy-five years, Mr. Laing led an active and creative life full of interest to the end.

He was born in Edinburgh, and received his early education at the Normal School in that city. With the intention of entering the business of his father, namely, that of a contractor and builder, young Laing completed his studies at the private school of James Baillie at Morningside, an establishment which was then famed for its business bent. At an early age he expressed an intense desire to become an engineer, and with that end in view was duly apprenticed to the firm of Messrs. Hogg and Walker, of Edinburgh, millwrights and engineers. The training which he received with that firm proved most valuable to him in later life, for besides acquiring a wide knowledge of engineering practice, he found many opportunities of developing his own resources. An important part of the experience Mr. Laing gained at that time was an intimate knowledge of the control of costs and the general financial side of engineering work, which stood him in good stead in the positions he was subsequently called upon to take up.

It was in the early days of March, 1877, that he was appointed to his first position in the designing department of John Elder and Co., of Govan, Glasgow, a firm which at a later date became the Fairfield Shipbuilding and Engineering Company, Ltd. At the time when he entered the Govan drawing-office the engineering department of the works was under the charge of the late Dr. Kirk, and it was Dr. Kirk's successor, Mr. Bryce Douglas, who in 1881 appointed Mr. Laing chief draughtsman in the engineering department. Four years later he took on the additional duties of assistant manager, and in 1887 was appointed general manager, with full control of the engine works, by the late Sir William Pearce. He held that position until 1890, when he was elected a director of the Fairfield Company. That office he continued to fill with great success until October, 1896, when he left the Clyde to become the general manager of the Wallsend Slipway and Engineering Company, Ltd.

The period of eighteen years during which Mr. Laing was with the Fairfield Company was particularly noteworthy for the progress made in the design and construction of steam propelling machinery, particularly for fast Atlantic liners. During it no less than twenty-seven hours were taken off the time required for the Atlantic passage, and the increase in the indicated horse-power of liners was about 30,000, with a great reduction in the fuel expended. The first engines with which Mr. Laing began his acquaintance with fast liner machinery were those of the "Arizona," in which three-cylinder compound engines were installed. The "Alaska" was laid down shortly afterwards, and other outstanding liners for which Mr. Laing designed the engines were the "Oregon" and the Cunard Line ships "Umbria," "Etruria," "Campania" and "Lucania." The engines for the "Campania," it may be recalled, had five cylinders, with the high and low-pressure cylinders placed tandem-wise on both the forward and after cranks, the intermediate cylinder being placed in the middle. This arrangement of cylinders was first introduced by Mr. Laing on the North German Lloyd liner "Lahn," for which company seventeen ships were built at the Fairfield yard. Other noteworthy liners of this period included several for the Union-Castle Line, the last being the "Dunvegan Castle," with 8500 I.H.P. engines. Mr. Laing's work at the Fairfield yard gained for him a wide reputation, both in this country and on the Continent, especially in Germany, on account of the ships he engined for the Hamburg-America and North German Lloyd lines. He also designed several sets of engines for naval vessels and fast cross-Channel steamers. In his eighteen years at Fairfield machinery aggregating 677,000 I.H.P. was constructed, for most of which he was directly responsible. Before he left for the Tyne he planned and carried out large extensions at the Fairfield yard, including new engine and boiler shops and fitting-out basins and a set of 130-ton shear legs. Mr. Laing also completely reorganised the machinery equipment of the engine works.

At the time he joined the Wallsend Slipway and Engineering Company, Ltd., at the end of 1896 as general manager and director, the works of that company were mainly laid out for the building of small and medium-sized engines, but he prepared and undertook a far-reaching scheme of reorganisation, which brought the plant quite up to date and made possible the economic construction of machinery for large naval vessels and the largest passenger and cargo liners. Under his direction the ship repairing department at Wallsend was greatly developed, and some noteworthy repair jobs were carried out. The principal Cunard Line ships, the machinery of which was built at Wallsend by Mr. Laing, included the "Invernia," "Carpathia," "Franconia," and the "Mauretania," the last-named liner being Mr. Laing's crowning achievement. The design and construction of the quadruple-screw 70,000 S.H.P. turbines for the "Mauretania" was carried out under his close personal supervision, and the success of the design may be best judged by the remarkable performance of that liner over a period of twenty-three years. When it was decided to recondition her turbines about two years ago Mr. Laing's advice was sought, and the record-breaking performance which the ship gave after her machinery had been reconditioned was largely due to the interest he took in that work.



ANDREW LAING]

The account of the work done by Mr. Laing at Wallsend would not be complete without some reference to the steamers and warships other than those already mentioned which were engined by the firm. One outstanding ship engined at Wallsend was the powerful ice breaker "Ermak," which was built for the Russian Government by Sir W. G. Armstrong, Whitworth and Co., Ltd. During the war no less than sixty-eight naval and mercantile ships were engined at Wallsend, amongst them two battleships, four cruisers, twenty-six torpedo-boat destroyers, besides submarines, sloops, mine-sweepers, train ferries and ice-breakers. Some of the largest machinery installations completed under Mr. Laing's supervision were those of the battleships "Queen Elizabeth" and "Malaya" and the mystery ship "Furious," which was later used as an aircraft carrier. The total tonnage represented by this machinery was over a million and a quarter.

In May, 1917, his Majesty bestowed the honour of C.B.E. on Mr. Laing in recognition of the services he had so unselfishly given to the country and to the marine engineering profession. In addition to being the managing director of the Wallsend Slipway and Engineering Company, Ltd., Mr. Laing was also a director of Swan, Hunter and Wigham Richardson, Ltd., and the Newcastle and Gateshead Gas Company.

His post-war work did not lack interest or creative genius. On the naval side he was directly responsible for carrying out the contract for the construction of the turbines of H.M.S. "Nelson," and the trials of that battleship. It is well known that for economy of fuel, both at high and low powers, no ship of this class has exceeded the standard of efficiency established by Mr. Laing's designs. The high-speed performance of the recently completed flotilla leader "Codrington," which was built by Swan, Hunter and Wigham Richardson, Ltd., and engined by the Wallsend Slipway Company, was another remarkable instance of the success which attended Mr. Laing's work.

While he shouldered with ease the heavy responsibilities which attached to his high office, he was always ready to help and to give credit to his colleagues and assistants. The able work done by the late Mr. Robert Traill is a remarkable instance of the inspiration which Mr. Laing's work gave to those who were privileged to co-operate with him. He was a great believer in the necessity for the team spirit, and although a born leader he was always glad to help in any difficulty which presented itself.

Apart from his official duties he found time for a remarkable amount of committee work, and those who were called upon to serve with him on the "Cunard" Committees, the Board of Trade Committees, the British Engineering Standards Committees, Lloyd's Technical Committee, the Institution of Naval Architects' Committees, the British Marine Engineering, Design and Construction Committee, and the Cast Iron Research Association Committee will not readily forget his remarkable personality or the value of his work.

He was a member of the Institution of Civil Engineers, the Institution of Naval Architects, the North-East Coast Institution of Engineers and Shipbuilders, and the Institution of Engineers and Shipbuilders in Scotland, and of the American Society of Naval Engineers, and the American Society of Naval Architects and Marine Engineers in New York. Last March the North-East Coast Institution of Engineers and Shipbuilders fittingly bestowed upon him the highest honour which it can give to its members by electing him to an honorary fellowship. He received this well-deserved honour almost with embarrassment, and in a characteristic reply spoke more of the work of his colleagues than of that which he himself had done.

Andrew Laing was perhaps the greatest marine engine builder of his day, and his name will long be honoured in our own country, in America and on the Continent of Europe. He saw propelling machinery change from the reciprocating steam engine of a few thousand horse-power, through the direct turbine to the geared turbine, culminating in the very large quadruple-screw installation for the new Cunarder now under construction, in connection with the machinery of which his advice was sought and given. He gladly accepted the newer form of propelling machinery, such as exhaust turbines and marine oil engines, and along with the system of oil firing, for which his firm is so well known, he left his own mark on all these developments. It has been granted to few men in recent years to spend such a full and useful life, and we feel sure that the example of Andrew Laing will go far to influence those who eventually must fill the great gap which his sudden death has created.

Agricultural Engineering.

(By our Paris Correspondent.)

AFTER investigating the economic problem for some years past the experts at Geneva are going to the root of the matter and endeavouring to place agriculture on a permanently stable basis. That is not easy, for the world is glutted with wheat, and consumers cannot be found for what is produced. There can be no question of limiting the production of grain, because that is essentially variable according to weather and other conditions, and the only solution proposed is to control sales and maintain prices on a fairly profitable basis, and institute a financial organisation which will come to the assistance of farmers in times of need. In a word, the price of grain must be stabilised, so that purely agricultural countries, which are desperately

poor on account of price depreciation and the impossibility of regulating supplies, will find themselves in a reasonable state of prosperity. Of all the difficulties in carrying out this scheme, the most serious is the competition of Russia. Under the Five Years' Plan the Soviet Government aims not only at producing unlimited supplies of grain by communistic farming and the use of machinery, but the equipment of the factories at Stalingrad and Rostov is intended to provide the country with all it needs in agricultural machinery and tractors. Whether it will succeed in disorganising the economic situation of agriculture in the rest of Europe is another matter. For the moment, the Geneva experts can only look to means of enabling growers to purchase all they need to carry on their industry and to control the produce, so that it can be supplied as required at stabilised prices. This does not imply the necessity of holding such enormous stocks as exist at present, for there are lean years when the supply is below demand, and the stocks are carried over to make up for any deficit.

The production of grain and other produce has been enormously increased with the aid of machinery, but there is no over-production in the right sense of the word. The trouble is the need of a proper distribution. Agriculturists are leaving this to the Governments and to the Geneva experts, and they look for immediate relief to more machinery, which will enable them to effect greater economies. At the same time, the depreciation of produce has left them with limited means for purchasing the machinery they require. This makes the situation extremely embarrassing for the agricultural engineer, who has never done more in the way of mechanical progress than in these times of stress. The annual Show of agricultural machinery which was recently held in Paris showed that the manufacturer is concentrating on economy in farming operations, while the agriculturist himself is fully alive to what is being done for him, and is prepared to take advantage of any new means of cheapening production if he can be assured of the effectiveness of the methods proposed. The Paris Show might seem to suggest that if growers are producing more than what is at present consumed, the engineer is manufacturing more than the farmer can buy. The situation really is that farmers must produce more with the same labour in order to obtain an assured profit, and they can only achieve that result by employing more machinery. Thus, larger quantities of machinery are being used, and an expansion of business is inevitable in view of the requirements of the French Colonies in Africa, where vast territories are being developed with little labour, and of the proposals to aid financially farmers in Rumania and other agricultural countries where one of the greatest needs is machinery.

In the great grain-producing districts in North Africa the combined harvester-thrasher and the heavy oil tractor are moving along parallel lines. Both have become indispensable, and the combined machine is only in its early period of usefulness. The tractor business has expanded in a way that is surprising in view of the force of inertia which farmers have always opposed to it. They wanted the tractor, but they were not sure that it was a practical proposition. That scepticism appeared well founded from experience extending over a number of years. But the heavy-oil engine and its successful application to tractors has broken down the prejudice at a time when French farmers find that they must employ mechanical haulage or go out of the business altogether. There is not enough manual labour, and what there is available is too expensive. With the solid injection oil engine fuel costs have been brought to an absolute minimum. The tractor is now accepted by the agriculturist as a necessary factor in economical farming, and brings in its train a larger employment of tractor implements which involves a new investigation now being carried out most successfully by foreign manufacturers. There are problems of design and resistance which foreign makers are beginning to solve, and it is fairly evident that the success of the tractor will, in some measure at least, help the British implement maker to secure some of the foreign trade.

While agriculture is as bad as it can be, it may be assumed that any change must be for the better. That hope is strengthened by the determination of the Geneva experts to bring about some international organisation which will make agriculture a stable industry. Hence, British agricultural engineers have every interest in holding strongly to their foreign connections. Some of them are doing so, as was evident from their participation in the agricultural machinery Show in Paris; others appeared to have dropped out in despair. There might be reason for discouragement in view of the great disparity in prices between English and foreign machines. In thrashing machines, English patterns and manufacture are universally appreciated, and some French makers have imitated English models, and sell their products at 30 per cent. less than English prices. There is one popular English oil engine of the solid injection type which is selling abroad successfully in competition, but there were very few other English engines at the Paris Show. Makers appear to have given up the struggle. Nevertheless, one French agent declared that he could sell any number of English oil engines if the prices were down to somewhere near the level of others; they are better, but the disparity in prices is too great for foreign buyers.

In all classes of English agricultural machinery the same tale is told, the difference in the prices of food-preparing machinery, for example, being usually 30 per cent., and in one case at least appreciably more. That is not all, for credit is becoming an increasingly important element in business, and even in France the low profits made by farmers compel them to demand credits which they had never dreamed of asking for in the past. Elsewhere in Europe the financial situation of farmers is generally so bad that German implement and machinery makers, backed up by the banks, allow credits of three and even five years. Under these conditions they can monopolise the business. This disability will be avoided if the proposed international financial organisation comes into being to advance money to farmers for the purchase of what they require.

It is difficult to see in what way English agricultural engineers can improve their situation in foreign markets. They are at present confronted with a competition which is not normal, especially from Germany, whose manufacturers must sell their goods somehow. They cannot allow the same long credits even if it were desirable, and they are apparently unable to get their prices down to a level at which the buyer's preference is not overruled by considerations of cost. This is a generalisation with some notable exceptions, for there are English firms which display admirable enterprise because they feel that they have implements and machines which foreign users must buy when they can be brought to appreciate them. England has always been a country of initiative in agricultural implement and machinery design, and makers continue to introduce something new to meet new conditions. But for the general run of agricultural engineering products, the price is a bar to trade. It has been suggested that if the amount paid in doles were handed over to manufacturers on condition that they employed an equivalent number of additional men, production would be increased and cheapened, and the machines could be sold abroad at competitive prices.

Lloyd's Register: Annual Summary

THE Annual Summary of the mercantile shipbuilding of the world for the year 1930 was recently published by Lloyd's Register, and, following our usual custom, we print below an account of the principal points that it covers. It should be remembered that this Summary does not include warships, and that it takes into account only merchant vessels of 100 tons gross and upwards, that were launched in 1930, whether they were completed during the year or are still under construction.

Sailing vessels fitted with auxiliary power are included with steamers or motor ships, according to type of engine.

GREAT BRITAIN AND IRELAND.

Particulars of Total Output.—During the year 1930 there were launched in Great Britain and Ireland 481 merchant vessels of 1,478,563 tons—viz.: 317 steamers of 712,283 tons, 141 motor ships of 759,282 tons, 22 barges of 6894 tons, and one composite sailing yacht of 104 tons, "Shamrock V." With the exception of this yacht and of one small wood yacht fitted with oil engines, all the vessels were built of steel. The output for 1930 was 44,060 tons lower than that for the year 1929. The present total represents 51·2 per cent. of the world's output for 1930, as compared with 54·5 per cent. for 1929, 53·6 per cent. for both 1928 and 1927, 38·2 per cent. in 1926, 49·5 per cent. in 1925, and 58 per cent. in 1913.

Nationality of Vessels Launched.—Of the tonnage launched during the year, 827,988 tons are for registration in Great Britain and Ireland and 650,575 tons—44 per cent. of the total tonnage—are for owners residing abroad. This percentage is the highest ever recorded by the Society. The previous highest percentage was reached in 1908, when 40 per cent. of the output of Great Britain and Ireland was intended for registration abroad. Similar figures for recent years are:—17·1 per cent. in 1929, 20·2 per cent. in 1928, 21·8 per cent. in 1927, 14 per cent. in 1926, and under 16½ per cent. in 1925. From one of the tables we see that no less than 301,224 tons were launched for Norway; 81,514 tons for the British Dominions overseas, and 69,858 tons for France.

Size and Type of Vessels.—The returns for 1930 show that 124 vessels of between 5000 and 10,000 tons each, and 9 vessels of 10,000 tons and upwards were launched. The largest is the quadruple-screw turbine steamer "Empress of Britain," of about 42,000 tons, which was the largest vessel launched in the world during 1930. Two other vessels of over 17,000 tons each were also launched, viz., the motor ships "Warwick Castle," of about 21,000 tons, and "Reina del Pacifico," of 17,300 tons.

Excluding vessels of less than 1000 tons, 77 vessels, of 550,475 tons—9 steamers, of 39,684 tons, and 68 motor ships, of 510,791 tons—for the carriage of oil in bulk, were launched during the year. Of them, 68 vessels, of about 508,000 tons, were built on the Isherwood system of longitudinal framing. The above totals include 28 vessels of 182,241 tons for registration in Great Britain and Ireland; 39 of 280,492 tons for Norwegian owners, and 10 of 87,742 tons for other countries. Including 13 small vessels, of 4809 tons, the total tanker tonnage amounts to 555,284 tons, and represents over 37½ per cent. of the total output for the year.

Not only are these figures much higher than any previously recorded, but they present a very interesting feature, viz., the very small proportion of tanker tonnage—7·2 per cent.—for the propulsion of which steam engines are still employed, and it may be added that all these steam tankers use oil as fuel for their boilers. The total tonnage of steamers fitted for burning oil fuel, launched during the year, amounted to over 280,000 tons. The returns include 15 yachts and a large number of vessels designed for channel, coasting, fishing—93 vessels—whaling, towing, harbour service, and other special purposes.

The average tonnage of steamers and motor ships launched during the year was 3213 tons. If the vessels of less than 500 tons are excluded, the average is increased to 4656 tons, as compared with 4443 in 1929, 4656 in 1928, 4193 in 1927, 4486 in 1926, and 4439 in 1925.

Vessels Fitted with Turbines.—Further progress was recorded in the use of steam turbines during 1930, when 16 vessels with a total tonnage of 107,276 tons were launched which will be fitted with that method of propulsion. These figures include the "Empress of Britain," which, as previously mentioned, is the largest vessel launched in the world during 1930. In addition, 9 vessels of 53,145 tons were launched which have a combination of reciprocating engines and low-pressure steam turbines, and 2 vessels, of 11,845 tons, for which the turbo-electric system has been adopted. It may also be added that auxiliary electric drive is used in one of the 9 vessels fitted with a combination of reciprocating engines and steam turbines.

Vessels Fitted with Internal Combustion Engines.—The tonnage of vessels fitted with internal combustion engines showed a remarkable increase in comparison with the total output. The tonnage of such vessels launched during 1926 was 201,913 tons, while during 1927 it amounted to 355,779 tons, to 427,916 tons during 1928, and to 464,188 tons during 1929. During the year 1930, 141 motor ships of 759,282 tons were actually launched, this tonnage exceeding by 47,000 tons the steam tonnage launched. The largest motor ship launched during 1930 was the "Warwick Castle," of about 21,000 tons—the largest motor ship launched in the world during the year. It may be of interest to note that while the average gross tonnage of the steamers of 500 tons gross and upwards launched during 1930 is 3568 tons, the similar average for motor ships reaches 6399 tons. It may also be stated that of the 95 vessels of 6000 tons and upwards launched during the year, 83 are motor ships.

Output of Leading Ports.—The Clyde district occupies first place among the shipbuilding centres, showing an output of 508,289 tons. Then follow the Tyne—323,750 tons—the Wear—173,306 tons—Belfast—168,606 tons—and the Tees—111,416 tons.

The largest increase, as compared with 1929, took place on the Tyne, the figures for which were 52,149 tons higher than those for the previous year. The increase at Belfast amounted to 24,751 tons. The figures for the Wear showed a decrease of 72,205 tons, for the Tees of 50,793 tons, and for the Clyde of 24,090 tons.

Progress of Shipbuilding during the Year.—As regards the movement of the shipbuilding industry during the course of 1930, Lloyd's Register Quarterly Returns show that at the opening of the year 1,560,254 tons were under construction in Great Britain and Ireland. The Returns issued during 1930 showed an increase for the end of March, since which date a steady and rapid decrease has taken place, the figures for the end of December, 908,902 tons, showing a decrease of no less than 651,352 tons, as compared with the tonnage being built at the beginning of the year. This decrease is the largest ever recorded during twelve months, with the exception of the year 1922, which was affected by the completion of the shipbuilding programme occasioned by the war.

From the Quarterly Shipbuilding Returns it is seen that the tonnage begun during the year—about 950,000 tons—was about 528,000 tons less than the tonnage launched during the same period from the yards in Great Britain and Ireland. In conjunction with the above-mentioned figures regarding the work in hand at the end of December, and in view of the generally known scarcity of new orders during recent months, it would appear that little prospect of an early improvement in the position of the shipbuilding industry of this country is to be expected, unless there should occur a speedier and more general revival of trade than present indications would seem to promise.

OTHER COUNTRIES.

Particulars of Total Output.—Attention is drawn to the statistics given in one of the tables, from which it appears that there were launched abroad during the year 603 merchant vessels of 1,410,909 tons—253 steamers of 540,199 tons, 280 motor ships of 823,712 tons, and 70 sailing vessels and barges of 46,998 tons. These figures do not include the tonnage launched in Russia, concerning which country complete information is not available. The total figures show a net increase of 140,322 tons as compared with those for 1929. The largest increases are shown in the United States—120,624 tons—Denmark—25,734 tons—and Sweden—24,535 tons—while in Holland there was a decrease of 33,445 tons, and in Japan of 13,185 tons.

Size and Type of Vessels.—The returns for the year include 30 vessels of between 4000 and 6000 tons each; 34 of between 6000 and 8000 tons; 35 of between 8000 and 10,000 tons; and 21 of over 10,000 tons each, the largest being the turbine steamer "L'Atlantique" of 40,945 tons launched in France, and the turbo-electric steamer "President Hoover" of about 22,000 tons, launched in the United States. There were launched during the year 29 vessels of a total tonnage of 243,074 tons to be fitted with turbines. This total included five vessels of 50,189 tons in which the turbines are used in conjunction with electric motors. In addition, seven vessels of 18,504 tons were launched which have a combination of reciprocating steam engines and low-pressure turbines. Excluding vessels of less than 1000 tons, the output abroad for the year also comprises 22 vessels, of about 202,000 tons, built on the Isherwood system of longitudinal framing. Including these vessels, which are all tankers, there were launched during the year 42 vessels of about 339,000 tons for the carriage of oil in bulk. Of these tankers, 33 of about 268,000 tons are fitted with oil engines.

During 1930 there were launched 280 vessels of 823,712 tons to be fitted with internal combustion engines, as compared with 270 of 805,700 tons in 1929. Sixty-one of those launched during the year are of over 6000 tons each, including 15 of 10,000 tons and upwards. Of those exceeding 6000 tons, 12 were launched in Holland, 11 each in Japan and Sweden, 10 in Germany, 6 in the U.S.A. and 5 in Denmark. The two largest are one of 16,990 tons built in France and one of about 16,000 tons built in

Holland. The total figures for motor ships include a few yachts and other sailing vessels fitted with auxiliary power. Of the steam tonnage launched abroad during the year, about 272,000 tons are fitted for burning oil fuel.

The tonnage of wood vessels included in this year's total is 6640 tons, as compared with 4903 tons in 1929 and 19,484 tons in 1928. With the exception of five sailing vessels of 659 tons, and four yachts of 508 tons, the totals for sailing vessels and barges are composed of barges, dredgers, car ferries and similar craft. The countries where the largest output took place during the year under review were U.S.A., Germany, Holland, Japan, Denmark, and Sweden. The totals for those countries amounted to 1,065,599 tons, and accounted for 75½ per cent. of the total output abroad.

UNITED STATES.

The output in U.S.A. for the year 1930, namely, 246,687 tons, was 120,624 tons higher than that for 1929. It represents 17·5 per cent. of the total output abroad, and is the highest recorded since 1921. Of the tonnage launched 17 steamers of 119,236 tons and 35 motor ships of 67,748 tons, were built on the Atlantic Coast; while six steamers of 29,665 tons and one motor ship of 1605 tons were built on the Great Lakes.

The largest vessel launched during 1930 was the "President Hoover," a turbo-electric vessel of about 22,000 tons, which was built at Newport News. Thirteen other vessels of over 8000 tons were launched. Twelve turbine steamers of 110,395 tons were launched in this country during 1930, including the above-mentioned "President Hoover," and four other vessels of 28,289 tons, in which electric drive is likewise employed.

Internal combustion engine tonnage launched amounted to 71,854 tons. Of oil tankers of 1000 tons and upwards, 13 of 104,674 tons were launched, seven of which of 55,536 tons are motor ships. The totals included 11 vessels of 98,424 tons, each of 1000 tons and upwards, and eight smaller vessels of 5881 tons, built on the Isherwood system of longitudinal framing.

GERMANY.

During the year under review, 92 vessels of 245,557 tons were launched in Germany. As compared with the output for 1929, the figures show the slight decrease of 3520 tons. They include eight vessels of 55,883 tons to be fitted with steam turbines and six vessels of 16,904 tons which have a combination of reciprocating steam engines and low-pressure turbines. The total comprises also 31 vessels of 117,205 tons to be fitted with oil engines, the largest being the motor ships "Monte Pascoal" and "Monte Rosa," of about 14,000 tons each. Nine tankers, of 86,977 tons, were launched, only one of which, of 9100 tons, is a steamer. The totals include 15 vessels of between 6000 and 10,000 tons, and six exceeding 10,000 tons each.

It may be of interest to state that of the total output in this country, no less than 48 vessels, of 124,178 tons—over 50 per cent. of the total output—are intended for other countries, including three vessels of 35,470 tons for Danzig, and 19 vessels of 34,598 tons for France.

HOLLAND.

The total tonnage launched in Holland during 1930—153,072 tons—was 33,445 tons lower than the 1929 figures. As usual, the figures do not include craft exclusively intended for river navigation, the total tonnage of which vessels reaches a high figure. Twelve vessels of over 6000 tons each—all motor ships—were launched, of which three exceed 10,000 tons each, the largest being the "Dempo" of about 16,000 tons. The totals for the year include 51 motor ships of 128,195 tons, which tonnage represents 83¾ per cent. of the total output for this country, and exceeded the output of motor ships of any other country abroad. Excluding ships of less than 1000 tons, three motor ships of 18,093 tons and one steamer of 5209 tons are intended for the carriage of oil in bulk.

JAPAN.

The output for Japan—151,272 tons—showed a decrease of 13,185 tons as compared with the total for 1929, but excepting that year was the largest total recorded for this country since 1921. The 1930 figures comprised 28 motor ships, of 123,894 tons, including the "Yasukuni Maru" of 11,930 tons, the "Hiye Maru" of 11,622 tons, the "Heian Maru" of about 11,000 tons, and eight others exceeding 6000 tons each. The motor ship tonnage accounted for nearly 82 per cent. of the total output for the year. One motor ship of 7280 tons was launched for carrying oil in bulk.

DENMARK.

The tonnage launched in Denmark during 1930—137,230 tons—was 25,734 tons more than last year, and apart from 1928, when 138,712 tons were launched, largely exceeded the output recorded for this country in any other year. Thirteen vessels of 67,017 tons were launched for Norwegian owners. The total was again composed mainly of motor ship tonnage—120,262 tons—which included 16 vessels ranging from 4500 tons to 7300 tons, and one of 9850 tons, the largest vessel launched during the year.

SWEDEN.

The figures in Sweden for 1930—131,781 tons—exceeded by 24,535 tons those for 1929 and were the highest ever recorded in this country. Over 90½ per cent. of the total is composed of motor ships—21 of 119,417 tons—of which eleven are of betwen 6000 and 9800 tons each. The tankers launched—all motor ships—amount to nine, of 69,082 tons. It may be stated that 15 of the motor ships, of 86,813 tons, are intended for Norwegian owners.

FRANCE.

The output of France for the year—100,917 tons—compared with 81,607 tons for 1929. The motor ship tonnage launched, 20,167 tons, is only just over one-quarter of the steam tonnage, while during 1929 it was nearly four times the steam tonnage.

Five vessels exceeding 7500 tons were launched, viz., the turbine steamer "L'Atlantique," of 40,945 tons—the largest vessel launched abroad during the year—the motor ship "Georges Philippar," of 16,990 tons, two turbine vessels of 8800 tons each, and a steam tanker of 7880 tons.

ITALY.

The total figures for Italy—87,709 tons—were 16,212 tons higher than those for 1929. The tonnage of the 15 motor ships launched during the year amounted to 71,361 tons, equal to 81·4 per cent. of the total output. The motor ships included the quadruple-screw vessel "Victoria," of 13,500 tons—the largest vessel launched during the year—and two vessels of 19,070 tons, intended for carrying oil in bulk, the larger being the "J. A. Mowinckel," of 11,330 tons.

PROGRESS OF SHIPBUILDING ABROAD DURING THE YEAR.

Dealing with the combined totals for the work in hand in the various countries abroad, not much change took place during 1930. At the beginning of the year the tonnage under construction amounted to 1,550,626 tons, while at the end of December the total was 1,417,184 tons. The latter figures, however, exclude the tonnage being built in Russia, from which country no recent returns have been received. The Returns for the fourth quarter show that at the end of 1930 the countries abroad having the largest amount of tonnage under construction were:—U.S.A., 232,030 tons; Germany, 218,215 tons; Italy, 179,677 tons; France, 174,215 tons; Holland, 160,078 tons; and Sweden, 145,750 tons. The countries which showed the largest increases are:—Italy, 101,758 tons; U.S.A., 52,968 tons; and Sweden, 47,310 tons; while considerable decreases took place in Japan, 97,510 tons, and in Holland, 71,856 tons.

In view of the high level of the tonnage now under construction abroad and of the fact that the tonnage begun during the year was nearly sufficient to replace the tonnage launched, it would appear that the shipbuilding industry abroad, taking it as a whole, is in a more favourable position than is the case in this country.

SUMMARY OF WORLD'S OUTPUT.

Another table shows that the total output during 1930 reached 2,889,472 tons. These figures represent an increase of 96,262 tons as compared with 1929. The output in Great Britain and Ireland represented 51·2 per cent. of the world's output during 1930, as compared with 54·5 per cent. in 1929 and 53·6 per cent. for both 1928 and 1927.

Some interesting facts may be gathered from this Summary as regards the special types of vessels and machinery included in the output of the year under review. The total launches comprised 40 vessels, of 300,161 tons, to be fitted with steam turbines; 16 vessels, of 71,649 tons, having a combination of steam reciprocating engines and turbines; and seven vessels, of 62,034 tons, for which the turbo-electric system has been adopted. Auxiliary electric drive is also used in the case of one of the 16 vessels fitted with steam reciprocating engines and turbines.

During 1930, 421 vessels totalling 1,582,994 tons were launched in which internal combustion engines are being fitted. This tonnage compared with 1,270,000 tons launched in 1929. The present total actually exceeds by over 330,000 tons the world's output of steam tonnage. In 1929 the motor tonnage launched amounted to 84·4 per cent. of the steam tonnage; in 1928 it was 80·1 per cent.; and in 1927, 62·8 per cent.

It should also be stated that the tonnage of motor ships being built in the world at the end of 1930 was actually 349,000 tons larger than the steam tonnage under construction, thus showing the progress which is being maintained in the employment of this system of propulsion. Of the total steam tonnage—1,252,000 tons—launched in the world, about 552,000 tons refer to steamers fitted for burning oil fuel under the boilers, so that the tonnage depending exclusively upon coal for propulsion is less than one-quarter of the world output for 1930.

The tankers of 1000 tons gross and upwards, launched during 1930 amounted to 119 vessels of 889,865 tons, as compared with 324,870 tons in 1929 and 646,851 tons in 1928. Of these 119 vessels, 101 of 778,854 tons are motor ships. In addition, there were launched 40 small tank vessels, of 18,569 tons, thus making a grand total of 908,434 tons, built for the carriage of oil in bulk. These record figures represent nearly 31½ per cent. of the world output for 1930.

During 1930 there were launched 90 vessels—of 1000 tons and upwards—of about 710,000 tons, built on the Isherwood system of longitudinal framing, all of which are built for the carriage of oil in bulk. A notable feature of this year's output is that while 39 vessels of 43,388 tons were launched in Norway for Norwegian owners, 90 vessels of 493,721 tons were launched in other countries for registration in Norway.

It will be of interest to compare the total of the world merchant fleets in 1914 with the latest available figures. Disregarding sailing vessels and all wood vessels, in view of their comparatively small importance in international trade, the gross tonnage of sea-going steel and iron steamers and motor ships amounted in June, 1914, to 42,514,000 tons, while at June, 1930, the figures reached 64,531,000 tons—a net increase of over 22 million tons during a period of sixteen years.

A remarkable change has taken place in the total tonnage of some types of vessels included in the above figures. For instance, the tankers which in 1914 totalled less than 1½ million tons now amount to over 7½ million tons; and motor ships, which in 1914 were under a quarter of a million tons, now amount to over 8 million tons—including auxiliaries. A great change also took place in the relative use of coal and oil fuel for boilers. In 1914 the gross tonnage of the steamers fitted for oil fuel was 1,310,000 tons, whilst the 1930 figures show 19,858,000 tons.

Fulham Generating Station.

THE Electricity Commissioners announce that, as a result of the public inquiry held on December 15th, 1930, and following days, they have given their consent to the extension of the generating station of the Metropolitan Borough Council of Fulham in Townmead-road, Fulham, in stages up to an installed capacity of 318,000 kW in aggregate, the first section, which the Borough Council has been authorised to carry out forthwith, having an installed capacity of 132,000 kW.

The consent places the Borough Council under statutory obligation not to work the generating station when extended so as to occasion a nuisance, and to that end requires the Borough Council to use continuously the most efficient methods which may for the time being be reasonably practicable for each and all of the following purposes respectively, namely, the elimination of smoke and grit; the prevention of the discharge of sulphur and its compounds into the atmosphere; and the avoidance of noise or vibration arising from the working of the generating station. The various conditions dealing with the foregoing mttaers were settled by the Electricity Commissioners in consultation with H.M. Office of Works and the Ministry of Health.

In the statement and report which they have issued, the Electricity Commissioners indicate that they regard it as fortunate that the London County Council and the Councils of the boroughs of Westminster, Kensington, and Chelsea decided to appear before them at the inquiry and indicate through counsel and witnesses the general considerations which in their position as public authorities they felt should be taken into account; and that as a result, they feel confident that every aspect of this question has been clearly and fully presented. In settling the conditions which have been imposed on the Borough Council of Fulham, the Electricity Commissioners have had due regard to those suggested by the London County Council and associated Councils at the concluding stage of the inquiry.

It was shown at the inquiry that all previous estimates of the growth of load in Greater London and surrounding districts have proved insufficient. The latest estimate of the Central Electricity Board shows that upwards of 153,000 kW of extra generating plant will be required in the year 1933–34 for the South-East England area as a whole, and that further additions at an average rate of about 175,000 kW per annum will be required in each subsequent year until the year 1940–41, by which date as much as 1,410,000 kW of additional generating plant will be required.

The additional load to be met in the West London area is estimated at about 123,000 kW in 1933–34 and over 293,000 kW by 1940–41. The Electricity Commissioners considered the following possible methods of meeting this demand:—

(1) By extending the Fulham generating station;
(2) By importing energy into the western area from a new generating station on the lower Thames;
(3) By extending a number of the existing generating stations in the West of London.

On the question of the relative cost of energy delivered in the western area of London from an extended generating station at Fulham and from a down-river generating station, the facts elicited by the inquiry and the additional particulars given in the report of the Electricity Commissioners show that the transmission costs would involve the Central Electricity Board in an extra cost of probably £116,000 per annum for the first stage and of probably £243,000 per annum on completion of the second stage, and that such extra costs might jeopardise the success of the regional scheme for South-East England.

On the question of the extension of a number of existing stations as an alternative to concentrating the plant in an extension of the Fulham station, the report of the Electricity Commissioners shows that the cost of the energy produced from the plant so allocated among individual stations would be increased by from 65 to about 104 per cent., and that a considerably greater tonnage of coal would be necessary than if the energy were produced from equivalent plant on the Fulham site.

Reviewing the alternative courses the Electricity Commissioners state that the case in favour of the extension of the Fulham station is conclusive on technical and financial grounds, and that the only reason for refusing or delaying consent would be the apprehension that no adequate safeguards are available for dealing with smoke, grit, and sulphur fumes.

The evidence given at the inquiry satisfied the Electricity Commissioners that the possibility of any nuisance arising from the emission of grit and dust can be obviated by the installation, as is proposed, of modern dust extraction plant, to which, in the case of the proposed extension at Fulham, is added the additional safeguard that the gases will subsequently pass through gas-washing plant. With regard to effluent water from the gas-washing plant, the Port of London Authority, which is the statutory body concerned, has laid down conditions which it considers satisfactory.

The remaining danger referred to in the representations is that from sulphur fumes, which it became clear in the course of the inquiry was the only issue of any importance.

As regards the emission of sulphur, it is recognised that the Fulham station will be in an especial position, as compared with other generating stations, since, as was pointed out in the representations, within a comparatively small radius of the Fulham station there are situate two other generating stations selected for the purposes of the South-East England Electricity Scheme, viz., Battersea and Wandsworth, and, in addition, another extensive power station is under construction at Battersea by the London Power Company. There are also the Lots-road power station and various large factories.

In this connection, the Electricity Commissioners point out that if their inquiry had been held before the successful experiments conducted by the London Power Company at the Grove-road generating station and the satisfactory reports on those experiments issued by the Government Chemists' Committee, they might have felt it necessary to delay a decision. Those experiments, however, showed that by the use of washing plant the sulphur content of the flue gases can be reduced to negligible quantities, and no evidence was submitted at the inquiry impugning the conclusions reached by the Government Chemists' Committee.

As previously indicated, the Electricity Commissioners have placed an obligation on the Borough Council to use the most efficient methods which may for the time being be reasonably practicable for preventing the discharge of sulphur and its compounds into the atmosphere.

Railway and Road Matters.

IN answer to a question, addressed to him on January 21st, as to the proposed London Traffic Bill, Mr. Morrison said that the discussions with the various authorities and bodies concerned were still proceeding, and he was not yet in a position to announce a date for the introduction of the Bill.

FIFTY-TWO miles of track on the Great Western are now laid with steel sleepers. The general type used is the G.K.N., which was described in THE ENGINEER of April 12th, 1929, but experimental lengths of other types have been laid. We understand that further extensions are proceeding.

THE syllabuses and the regulations for the examination of candidates for admission to the Institute of Transport have been revised and come into force on October 1st next. With the object of securing uniformity of railway education and examination the syllabuses were evolved by representatives of the four grouped companies: the Metropolitan Railway, the London Underground and L.G.O.C. group, of certain English universities, and of the Institute, and have been adopted by the railway companies and the Institute.

THE Southern Railway Company has replied to the proposal, mentioned by us on January 2nd, for the reopening of the Norwood Junction-Beckenham Junction connection, that that would necessitate a considerable expenditure which could not be justified. Furthermore, a service between those stations would give little advantage over that instituted in March, 1929, to Victoria *viâ* the Crystal Palace, and that it was impossible to run trains through to East Croydon owing to the existing track occupation.

THE extension towards James Bay of the Temiskaming and Northern Ontario Railway has been completed to Coral Rapids, a distance of 96 miles, leaving 100 miles to its objective at Moose River to be constructed this year. The new line will give the road a total mileage of 609 miles and will provide Ontario with a port at tidewater. This extension will open up a region rich in minerals and timber, and possessing great agricultural possibilities, in addition to giving the province railway communications from the Great Lakes to the Sub-Arctic regions.

THE Transportation Act, 1920, under which the railroads of the U.S.A. reverted from Federal Control during the war to the *status quo ante*, ordered the Inter-State Commerce Commission to prepare a plan for the consolidation of the roads "into a limited number of systems." In December, 1929, the plan was issued and thereunder the combined systems were to number 21. It is now announced that the Eastern railroads, except those in New England, are to be combined into four, which are to be known as the Pennsylvania, the New York Central, the Baltimore and Ohio, and the Chesapeake and Ohio.

THE ceremony of handing over to the Compagnie du Metropolitain the Porte de Charenton-Ledru-Rollin section of line No. 8 has been performed by the company's director of technical services. This line, which runs under the boulevards, is to be completed for the opening of the Colonial Exhibition, and the company has made all arrangements to ensure the opening early in May. The substructure is almost completed between the Richelieu-Drouot crossing and the Chaligny station, except towards the Boulevard Saint-Denis, where the work is particularly extensive, and at the Bastille, where the tunnel passes under the Saint-Martin Canal.

THE Carlisle derailment of January 3rd is likely to raise the question as to the adoption of some means to ensure obedience to speed limitations. It might be thought that that could be done by an arrangement of automatic train control similar to that used for stopping trains should they pass signals at danger. But that system achieves a different object from that necessary at curves, inasmuch as control at a signal will bring a train to a stand unless the driver takes steps himself to stop it. At a curve the train has not to be pulled up, but only to have its speed reduced to a certain minimum. The trouble is that these speed limits vary in their amount and in their length, and it is difficult to arrange mechanism on a heavy moving mass like a locomotive that would respond to the rate of speed determined by the distance covered in a predetermined time. The control would have to be withdrawn after a certain distance—which would constantly vary—had been covered, and into all these calculations there would enter the question of the weight of the train and of the gradient.

THE report of the Administration of the South African Railways for the year ended March 31st, 1930, contains some important remarks under the heading of Diesel-electric locomotives. Engines of that type would, it was considered, be useful on certain branch lines where, owing to bad water, remoteness of coal supplies and other conditions unfavourable to steam traction, the internal combustion engine, which carries its own supplies of oil fuel and cooling water, would be more suitable. The results of the inquiries made by Mr. E. A. Watson, the Chief Mechanical Engineer, on the occasion of his recent visit to Europe, are, it is said, disappointing, and indicate that the disadvantages of heavy initial cost, complicated design and excessive weight have not yet been overcome. The cost is approximately three times that of a steam locomotive of similar power, and although the standard of efficiency is claimed to be high, any advantage from the point of view of economical working is, to a great extent, offset by the additional interest charges on the increased capital outlay and the high cost of oil fuel, which, in South Africa, is sixteen times that of coal. The fuel costs of the Diesel locomotives would be nearly 50 per cent. greater than those of the ordinary steam locomotive on the South African Railways. There were no indications pointing to the general adoption of the Diesel locomotive by any of the countries in which it is being tried. Mr. Watson found that the consensus of authoritative technical opinion was that the oil-electric locomotive is still in the experimental stage, and it is quite evident that some time must elapse before an oil locomotive is produced which will be suitable, from the standpoints of efficiency and economy, to South African conditions.

Notes and Memoranda.

THE stand-by crane which has been installed on the Welland Canal in Canada, for handling the lock gates there in the case of emergency, besides being capable of a vertical lift of 500 tons, has a 125ft. jib for 125 tons. The winches are all worked electrically from a steam-driven plant.

IN the Empire State Building, New York, which is eighty-six storeys high and has an estimated population of 25,000, there are fifty-eight passenger lifts and six goods lifts. The express lifts run at speeds of 800ft., 1000ft., and 1200ft. per minute, and escalators are installed between floors to prevent the delay of the lifts by short interfloor traffic.

THE circulating water pumps serving the single-pass 55,000 square foot condenser at the James H. Reed station on Brunot's Island, near Pittsburg, depart from customary practice, both as regards the type of pump and their position in the plant. The two pumping units of vertical propeller type are each rated at 40,000 gallons per minute, against a total head of 16·63ft. They are driven at 575 r.p.m. by 350 H.P. vertical induction motors. They have, says *Power*, an efficiency of 85 per cent.

THE designing of "all-electric" or "all-gas" houses may, says Professor C. R. Darling, be an excellent method of advertising, but either is quite impracticable in the average home in this country, owing to the costs entailed in installation and upkeep. Moreover, it is foolish to use either of these sources of heat and light in cases in which the other is more efficient and cheaper, or when solid fuel is better than either. The house should be fitted with the best and most economic appliance of its kind regardless of the medium used to operate it, but with full consideration of the domestic routine. Neglect of this has resulted in the houses on some estates being costly to maintain and not as convenient to live in as might have been the case.

THE danger of testing steam vessels under steam at pressures in excess of those for which they were designed is emphasised by an accident in a Birmingham works that resulted in two men being badly injured. The vessel, a copper autoclave, was intended to work at a pressure of not more than 45 lb. per square inch, and on completion was tested hydraulically to a pressure of 80 lb. with satisfaction. It was then heated up to produce a steam pressure of 70 lb., when the end blew out. The Engineer Surveyor-in-Chief of the Board of Trade quite properly remarks that although such a practice may have been carried out in these works for the past thirty-five years, it is to be strongly deprecated, and that apparatus of this character should be tested hydraulically to at least twice the intended working pressure, and any steam test that is applied should not exceed the intended working pressure.

A FULL general account of the zinc industry is given in "Zinc," the latest of the series of mineral monographs issued by the Imperial Institute, and just published by H.M. Stationery Office, price 3s. The monograph may be regarded as a revised edition of two monographs on "Zinc Ores" and "Zinc," issued respectively by the Imperial Institute and the late Imperial Mineral Resources Bureau. The major portion of the publication is devoted to the world's resources of zinc ores—with special reference to those of the British Empire—in which the principal deposits of the different countries are succinctly described. From the information given it is possible to visualise the immense reserves of zinc ore existing in the British Empire. An important feature of the monograph is the large amount of statistical information, which includes tables showing the production, import and export of zinc ore, metal and compounds during the past ten years for all important countries. A very full bibliography completes the volume.

THE sales of aircraft, engines, and landing gear in Canada during the first nine months of 1930 amounted to approximately 2,482,373 dollars. An analysis of the figures, which make up this total, indicates clearly that Canadian companies are well equipped to supply the country's rapidly growing needs along aviation lines. At present eight companies are engaged in aircraft construction; two in landing gear construction only, and three in aero-engine assembly, rebuilding, and overhaul. New aircraft manufactured totalled sixty-nine, and had a sales value of 1,098,086 dollars. Aircraft, assembled or rebuilt, totalled fifty-four, and had a sales value of 401,500 dollars. Aero-engines, assembled or rebuilt, numbered 171, and had a sales value of 413,839 dollars. The landing gear manufactured consisted of 120 sets of floats and 37 sets of skiis, a total of 157; these had a sales value of 130,248 dollars. In addition, ten gliders, having a total valuation of 5000 dollars, were constructed. Canada imported, during the first nine months of 1930, fifteen aircraft from the United States, which had a sales value of 330,700 dollars; and also nineteen aero-engines of British construction were sold, at a sales value of 103,000 dollars.

IN concluding a paper on "Coal Mining Practice," given before the Institution of Mining Engineers, Mr. F. C. Swallow said that the greatest economies in coal mining can be effected at and near the coal face. The next step is the use of coal loading machines, to eliminate the great waste of human effort so evident in a visit to most coal mines. The use of the drag scoop would appear to have many advantages and few drawbacks, a fact being realised to-day by many engineers. Outputs per man-shift worked about the coal face can be, and are being, pushed up to over 20 tons, in place of the 5 or 6 tons so usual with even semi-mechanised mining as practised widely to-day. Finally, it would appear that the ideal colliery would be laid out somewhat along the following lines:—The coal would be undercut by machinery, loosened by explosives, and removed by self-loading scoops or other mechanical means. The roof supports should be of steel throughout. The main haulage for short distances would be by conveyor, and for long distances with the use of large-size tubs of 6, 8, and 10 tons capacity each. For the deeper mines winding would be by means of the tipping skip. On the surface the coal would be separated from the dirt by a gravity separator and, after cleaning, would be screened to the size required. Such a pit would have an output in the neighbourhood of 15 tons per man-shift worked, all told, in a seam of, say, 4ft. to 5ft. in thickness.

Miscellanea.

A NEW well in the Turner Valley, Alberta, is said to have a flow of gas of 43,500,000 cubic feet daily.

A SOCIETY called the British Society of Motion Picture Engineers was initiated at the rooms of the Royal Photographic Society on January 19th.

IT is said that the exportation of some 5 to 7 million cubic feet of timber from Soviet Russia to Memel, will provide employment to about 2000 men in its conversion before dispatch overseas.

A DEMONSTRATION with aerial gliders towed by motor cars is to be given at Hanworth Air Park. It is not intended to go to any great height, although, in America, heights as great as 2000ft. have been attained in this way.

THE death is announced as having taken place on January 24th, 1931, at St. Raphael, Alpes Maritimes, France, of Monsieur Gustave Trasenster, who was President of the Ste. Ame. d'Ougree-Marihaye, Ougree, Belgium. Monsieur Trasenster was in his 76th year.

THE Ontario Hydro-Electric Power Commission proposes to expend 4,380,000 dollars on 1850 miles of primary power lines to supply rural consumers. It is expected that there will be over 9700 new connections. By the end of this year the whole system will have about 9000 miles of line.

THE new steam power plant of the British Columbia Electric Railway Company, at Vancouver, has been put in commission. It has a capacity of 6700 horse-power, and brings the output of the steam plant of the company up to 23,500 horse-power. Including the five hydro-electric plants of the company there is now available 225,550 horse-power.

THE result of the Sisal Competition just held in Nairobi at the Kenya Agricultural and Horticultural Society's Show was a victory for Bird and Co. (Africa), Ltd., whose machinery was made at Lincoln by Robey and Co., Ltd. The Mackenzie Cup for most points in the sisal classes and first prizes for No. 1 and No. 2 Sisal were all won by Bird and Co. (Africa), Ltd.

IT is announced that H.R.H. the Duke of Gloucester will be the principal guest at the Government banquet at the Guildhall, London, on February 16th, to celebrate the opening of the 1931 British Industries Fair in London and Birmingham. Some two thousand entirely new products are to be exhibited at the Heavy Industries, or Birmingham, Section of the Fair.

FOURTEEN of the leading French publishing firms which specialise in the production of technological literature have combined to produce a "Bibliographie des livres français d'Industrie et de Technologie." The lines of the "Catalogue of British Scientific and Technical Books" of the British Science Guild have been closely followed, with slight modifications.

THE St. Lawrence Power Development Commission of New York has just put forward a scheme by means of which 2,200,000 horse-power could be developed on that river at one site and at a cost of 171,547,000 dollars. It is suggested that a dam should be constructed at Massena to a height of 50ft. so that 600,000 horse-power could be produced, and that when a market for that amount of power had been found, the dam should be raised by 35ft., when an additional 1,600,000 horse-power could be developed.

THE Secretary for Mines makes the following announcement with regard to the Safety in Mines Research Board. Sir Thomas H. Mottram, C.B.E., who, in December, 1928, accepted re-appointment for two years to enable him to finish certain investigations, has now completed his term of service. Professor S. M. Dixon, M.Sc., B.A.I., M. Inst. C.E., Professor of Civil Engineering at the City and Guilds (Engineering) College, would normally have retired on December 31st, 1930, under the scheme of rotational retirement, but has agreed to an extension for one year to complete the work in hand. Mr. D. B. Woodburn has been appointed Secretary to the Board, *vice* Mr. A. D. Stedman, M.B.E., promoted to another appointment in the Mines Department. The name of the member to replace Sir Thomas Mottram will be announced later.

FROM three different points in Russia separated by great distances, reports have been received of the starting of building operations on three great electrical power stations, to form part of the general scheme for electrifying the country adopted ten years ago. Voronieszh, in Central Russia, has embarked upon the construction of a 48,000 kW station, to supply power to its industries. Novossibirsk, the rapidly growing capital of Western Siberia, reports the laying of the foundation stone of a power station with a capacity of 100,000 kW. Among the factories working on power from that station will be the great combine harvester plant, which is under construction near the town. Finally, Verkhneudinsk, the principal town of the Buriato-Mongolian Republic, announces that work on a power station to supply all the factories in the region has just begun there. An appropriation of 850 million roubles—£85,000,000—is being made this year for electrification purposes.

AS a result of recent increases in the tariff, some lines of construction and industrial machinery hitherto imported will be produced in Canada. For instance, a company under the name of the Dominion Hoist and Shovel Company is being organised jointly by the Dominion Bridge, Dominion Engineering, and the American Hoist and Derrick Company for the manufacture in Canada of excavating shovels, locomotive and crawler cranes, revolving cranes, hoisting machinery and derricks. It will use the designs of the American company, which has been one of the principal exporters to the Canadian market. Then, too, the Dominion Bridge Company, of Montreal, has entered into an agreement with the Steel Pipe and Line Company (Hume's), Ltd., of Australia, to form the Hume Pipe Company (Canada), Ltd., to manufacture concrete pipes, plain and reinforced, steel pipes, concrete-lined, with protective coatings on the outside, for which it will have the exclusive right of the Hume patents in Canada.

THE NAG HAMMADI BARRAGE ON THE NILE

MESSRS. COODE, WILSON, MITCHELL AND VAUGHAN-LEE, MM. INST. C.E., WESTMINSTER, ENGINEERS

(*For description see page* 123.)

FIG. 11—SECOND SEASON'S SUDD, SHOWING CONDITION OF WORKS ON JANUARY 30, 1929

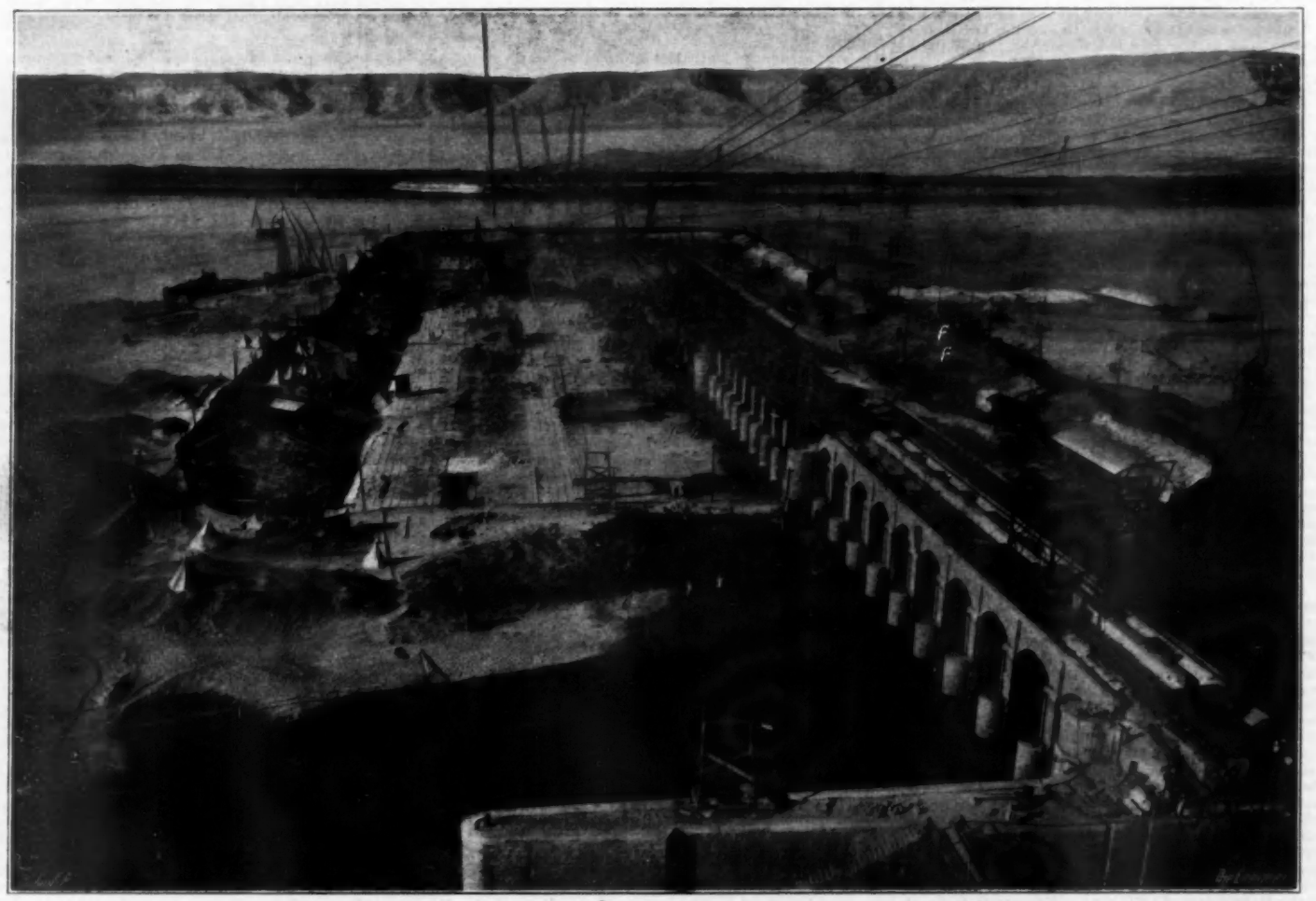


FIG. 12—SECOND SEASON'S SUDD, SHOWING CONDITION OF WORKS ON MAY 4, 1929

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Contents.

THE ENGINEER, January 30th, 1931. PAGE

A SEVEN-DAY JOURNAL .. 121
THE NAG HAMMADI BARRAGE. No. I. (Illus.) .. 123
INSTITUTION OF MECHANICAL ENGINEERS. (Illus.) .. 124
REINFORCEMENT OF STONEY CREEK BRIDGE. (Illus.) .. 125
LETTERS TO THE EDITOR—
The "Rockets" .. 128
Oil Engine Nomenclature .. 129
French Railways and Electrification .. 129
THE MEOPHAM AEROPLANE DISASTER .. 129
OBITUARY—
Andrew Laing .. 130
AGRICULTURAL ENGINEERING .. 130
LLOYD'S REGISTER : ANNUAL SUMMARY .. 131
THE FULHAM GENERATING STATION .. 132
RAILWAY AND ROAD MATTERS .. 133
NOTES AND MEMORANDA .. 133
MISCELLANEA .. 133
LEADING ARTICLES—
The Meopham Aeroplane Disaster .. 135
Peak Loads on Power Systems .. 136
ENLARGEMENT OF THE KINGSWAY SUBWAY OF THE L.C.C. TRAMWAYS. (Illus.) .. 136
SIXTY YEARS AGO .. 137
BOOKS RECEIVED .. 137
HIGH-PRESSURE LOCOMOTIVES. (Illus.) .. 138
HIGH VOLTAGE TESTING .. 141
CERTIFICATES AND DIPLOMAS IN ENGINEERING .. 141
COLLIER WITH GRAB CRANES. (Illus.) .. 142
THE CLACTON RAILWAY ACCIDENT. (Illus.) .. 142
LAUNCHES AND TRIAL TRIPS .. 142
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 143
Lancashire .. 143
Sheffield .. 144
North of England .. 144
Scotland .. 145
Wales and Adjoining Counties .. 145
CALENDARS, DIARIES, &C. .. 145
CONTRACTS .. 145
CATALOGUES .. 145
CURRENT PRICES FOR METALS AND FUELS .. 146
FRENCH ENGINEERING NOTES .. 147
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 147
FORTHCOMING ENGAGEMENTS .. 148
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 148

SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

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The Metallurgist.

THE JANUARY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

VOL. CLI No. 3916

JANUARY 30, 1931.

The Meopham Aeroplane Disaster.

BY publishing the report of the Accidents Investigation Sub-committee on the disaster which happened to a Junkers all-metal monoplane at Meopham on July 21st, 1930, the Air Ministry has departed from its previous policy, under which all such reports were regarded as strictly secret. It is not definitely known whether that policy is now to be permanently abandoned, but there can be no doubt that in this instance the opening of the report to public inspection was justified, and in the end will prove beneficial to aeronautical interests. The accident was of a peculiarly distressing nature. The aeroplane to which it happened was typical in its design and construction of modern practice, and was in the charge, if not at the moment actually under the control, of one of the most experienced and skilful of British pilots. Flying normally, it passed into or behind a cloud. Half a minute later a noise was heard and the machine in a dismembered condition and its occupants were seen falling to the earth. All on board—two pilots and four passengers—were killed. There was no immediately obvious explanation for the disaster. A lengthy investigation of the circumstances by Major Cooper, the Air Ministry's Inspector of Accidents, failed to yield any definite conclusions as to its cause. Three months after it happened the Accidents Investigation Sub-committee, to which body the duty of inquiring into the disaster had been transferred, was still unable to form any reasonably possible explanation which would fit the known facts. Many people felt disquieted. It almost seemed that after all the years of toil and sacrifice the aeroplane was still open to sudden, inexplicable, apparently causeless destruction in the air. The equally sudden and tragic disaster some time later to the airship "R 101" did much to reinforce that impression. Whatever view may be taken regarding the calamity at Beauvais, it was essential, in order to restore public faith in aeronautical science, that the inquiry into the cause of the Meopham accident should be prosecuted until a conclusion of more than reasonable probability as to its origin was reached, and that when it was reached it should, whatever its nature, be publicly disclosed.

One by one the Accidents Sub-committee studied and discarded various familiar possible causes of the disaster. Two received particular attention. It was possible that the machine might have been broken in the air by the rough handling of the controls. That explanation has accounted, or been held to account, for many mishaps involving structural failure in the air. It is relatively easy for the pilot of any machine to break his wings by the too violent use of the controls. The manner in which the Junkers machine broke into pieces was, however, quite different from that characteristic of this cause of failure. The Sub-committee discarded the explanation as one which could be accepted only with great difficulty. Particular attention was also paid to "tail flutter" as the cause of the accident. Flutter is the name given to a rapid and large oscillation of the wings or tail of an aeroplane, caused by aerodynamic instability and influenced by the elastic and other properties of the structure. It is a phenomenon of comparatively recent discovery and study, but it has already been firmly established as a potent source of accident. There were particular reasons for believing that the structure of the Junkers machine failed first in the neighbourhood of the tail. For that reason, tail flutter seemed to provide a very possible cause for the disaster. Experiments were made, but they proved that in the Junkers monoplane tail flutter could not occur unless the machine were travelling at a speed of 250 m.p.h. or more. Tail flutter, therefore, had to be eliminated as an explanation. With the abandonment of these two possibilities, all probable familiar causes were exhausted. The conclusion ultimately reached was that the most likely primary cause of the disaster was a phenomenon, the existence of which had previously barely been suspected and of which the potentiality as a source of accident had not been recognised. That phenomenon is so new to the aeronautical world that the Sub-committee in its report gives it a name for the first time. It is called "buffeting." Whereas tail flutter is a rapid and regular vibration of the tail unit, arising from aerodynamic instability, buffeting, according to the Sub-committee, is an erratic up-and-down bending of the tailplane, produced by eddies thrown off from the main planes. It has not so far been systematically investigated, but it is believed to be particularly liable to occur in low-wing monoplanes; that is to say, in machines of the type to which the Junkers machine belonged. Experiments at the National Physical Laboratory have shown that under certain conditions, buffeting in a monoplane of that type can at speeds less than the cruising speed attain a violence sufficient to break the tail.

To the general public it may seem that the Sub-committee, faced with the duty of finding an explanation of a disquieting accident, and failing to make the facts square with any familiar cause of disaster, has been driven to invent or discover a new one. Aeroplanes, it may be argued, have been meeting with accidents for the past twenty years and more. If, then, "buffeting" is, as it would seem to be, a likely cause of mishap, why, in the searching light of modern aeronautical science, was it not detected long ago? The answer to that question is, as we see it, of general significance. It is very doubtful whether until recent times buffeting presented any serious risk of failure. It is, or appears to be, a product of current tendencies in aeronautical design. Whether it occurs to a dangerous extent only in low-wing cabin-type monoplanes is a point which, no doubt, will, in view of the growing popularity of that design, be thoroughly investigated. At present, however, the indication is that that form of machine—a form of recent development—is particularly and perhaps exclusively open to its occurrence on a serious scale. Much the same might be said regarding wing and tail flutter. These phenomena as possible causes of disaster are of recent recognition. They have not, however, been in existence, undetected, from the beginning of practical flying, but have become prominent because of modern developments, notably because of the advance in speed and the adoption of steel construction. It would be wrong to infer from the circumstances of the Meopham disaster that aeronautical science is still in ignorance concerning some of

the elemental factors on which safety in flight depends. The art of aircraft construction is at a stage of very rapid development. Its progress is bound to be accompanied by the introduction of new possibilities of failure. If aeronautical science is to be blamed for the disasters which occur, it may well plead that the circumstances in which it works are such as to make it concentrate its attention far more on the enhancement of performance and achievement than on the discovery of the fresh risks and dangers which such enhancement may introduce.

Peak Loads on Power Systems.

THE first man who ever looked into the economics of a power station must have noted and deplored the increase in production costs brought about by the daily and seasonal variations in the demand for electricity. As soon as ideas became precise, the term load factor was invented, and the improvement of the load factor has since been the constant care of all those engaged in the business. The effect of a bad load factor is not, as is so often imagined, to increase the fuel and steam consumption for a given output because for part of the time the plant is only partly loaded, and is therefore running inefficiently. It has been abundantly demonstrated that the fuel consumption of a power plant when plotted against the electrical output follows a straight line law with practical exactitude, and that being so it is a necessary consequence that the total fuel consumption over a period of time for any given equipment and management is determined solely by the quantity of electricity produced, and is quite independent of the shape of the load curve. So far as fuel consumption is concerned, there is, therefore, practically nothing to be gained by increasing the load factor, unless by that means the output of the station is increased. It is well that this point should be made clear, as there seems to be so much misunderstanding about it. The really serious consequence of a poor load factor is to saddle the output with heavy capital costs per unit generated, and thus to add to the true works costs a large item which is outside the control of the station engineer. It is obviously impossible to sell current cheaply when a lot of expensive machinery is idle, or is only earning little for the greater part of the time. Hence, extraordinary efforts have been made, by means of special tariffs and otherwise, to encourage the use of electricity during the slack hours, and a considerable measure of success has been obtained. Nevertheless, when all is said and done, there is no means of selling more electricity at any particular time than customers need at that moment. The average factory can never take as much current between 2 and 3 a.m. as during the normal working hours, nor will the June demand for electric light ever compare with that of December.

However attractive the tariffs, however active the salesmanship, and however good the diversity factor, there must come a time when the load factor of any given area can be no longer improved. In many cases we are nearing that point now, and the power station designer is being forced to see what he can do to meet the situation. Since the demand can never be made uniform to suit the convenience of the machinery, the problem which presents itself is that of dealing in the most economical way with such peaks as will always remain. Simply to put down enough ordinary machinery to carry them, as has been the general practice up to now, involves just that expense which it is the object to avoid. In an old station there is usually the possibility of bringing into service obsolescent and relatively uneconomical plant to carry the load over the peaks, the base load being served by the newer and more efficient machinery. A development of the same idea is to have separate base load and peak load stations on a system, the latter being designed more with regard to low capital costs than to thermal efficiency, since their hours of operation are short. Any expedient of this nature, involving separate plant, requires the latter to be capable of taking-over load immediately in cases of emergency, a condition which complicates the problem. The heavy oil engine gives quick starting, and a separate station containing two 7500-kW oil engine sets is in use at Henningsdorf to deal with peaks on part of the Berlin system, but unfortunately the special characteristics of the oil engine, namely, heavy capital costs and low running costs, are just the converse of what peak load plant requires. The steam accumulator has also been adopted by the Berlin authorities, but all that such apparatus can do is to relieve the boiler-house of the peak, without any corresponding assistance to the generating plant. The demand of the consumers is for electricity, not steam. And how sudden and insistent this demand can be, in the case of a sudden fog, for example, many power stations know to their cost. The London Power Company has always to carry banked boilers ready to come in at a few minutes' notice, and to have generating machinery in equal readiness. In New York a thunderstorm may raise the demand by as much as 350,000 kW in a few minutes, and the Hell Gate station is reported to have had to deal with a load rising at the rate of 3000 kW per minute for three hours. Since no public power supply system can escape the necessity of dealing, not only with its normal peak loads, but with sudden emergency loads, due to special weather conditions or a failure of some part of the generating equipment, the nature of the plant best suited for such service has afforded much food for discussion. The use of old power stations, when such exist on the system, to carry the normal peaks, raises the almost insoluble question of staffing such stations economically, and apart from this, it may be difficult to bring such stations into service with the rapidity called for by an emergency. The same objections hold, though in lesser degree, for special auxiliary stations equipped with oil engines. Instead of seeking strange ways of dealing with peak loads, it would seem preferable first to exhaust the possibilities of the ordinary running plant. All steam turbine machinery is capable of carrying a fair overload for a short time, and, furthermore, it takes care of the overload automatically, however suddenly it comes on. The natural course would appear to be the development of these characteristics by increasing the overload capacity of the turbine, and providing special means for cooling the alternator. Then, without extra machinery or staff, and without destroying the homogeneity of the plant, very considerable overloads could be carried as long as might be desired, with very little sacrifice of economy. This was the solution advocated by Sir Charles Parsons and Mr. Robert Dowson in a paper presented to the last World Power Conference in Berlin. They showed that a turbine constructed to give a range of operation greatly in excess of the economical load, and involving neither radical changes in design, nor unduly increased first cost, need have no reduction of efficiency at overloads other than that due to the falling off of the vacuum. And even that would be partly compensated for by the increased temperature of the condensate. The turbine, under the scheme of the authors, would have a continuous overload capacity of 75 per cent. instead of the usual 25 per cent., and the alternator could be made to carry the same overload continuously, by cooling its ventilating air by brine tanks, as originally proposed by Mr. I. V. Robinson. Mr. Robinson's scheme was to store "cold" in the form of brine during periods of normal load, and to apply this cold to the cooling of the air when the alternator was overloaded.

There is so much to be said in favour of the idea of temporarily increasing the capacity of the ordinary plant at times of peak load, rather than having recourse to other units, that it is not surprising that the question is being exhaustively studied. The latest scheme is one proposed by Professor A. G. Christie and Mr. Warren Viessman in a paper read before the A.S.M.E., a few weeks ago. These authors confine their attention to the turbine, leaving the cooling of the generator out of consideration. Their proposals are the more interesting in that they seek to increase the capacity of existing standard machines, constructed merely for their ordinary rating. To get them to give more power, they suggest dispensing with the steam normally employed for progressive feed-water heating, so that this steam may be diverted to the production of useful work in the turbine, at times when extra power is needed. With a four-heater turbine, it is estimated that the power could be increased by 17·7 per cent. by this method, and 21·25 per cent. with a five-heater turbine. The obvious objection that the boilers must not be supplied with cold feed water when the heaters are shut off is met by providing hot water accumulators from which the feed is maintained. The hot water accumulators are charged from the boiler at times of low load, and pressure is maintained in them by steam from the high-pressure tapping point of the turbine. The various heaters are automatically put out of action by opening a single valve, so that it is simple enough to make the change over. On the other hand, the accumulators are somewhat of a problem. To increase the net output of a station from 57,630 kW to 67,825 kW for a period of two hours only, no less than 1,366,000 lb. of very hot water would have to be stored, according to the calculations made by Professor Christie. This would require three accumulators each 12ft. diameter by 80ft. long, with hemispherical ends and subjected to an internal pressure of about 150 lb. per square inch. To find room for such accumulators in any convenient position would be a puzzle for most power stations, and their cost is not a negligible item. Professor Christie puts the additional cost for such an installation at 24·36 dollars per kilowatt of added peak capacity, and compares this favourably with the cost of the equivalent extra generating plant. The real advantage of his system would, however, appear to be its applicability to many existing turbines. For a new station it would seem decidedly better to install turbines capable of very large overloads, as suggested by Sir Charles Parsons, especially as that course would not limit the time that the peak could be carried, which is a restriction necessarily involved in all accumulator systems.

Enlargement of the Kingsway Subway of the L.C.C. Tramways.

THE enlargement of the subway on the tramway system of the London County Council, which connects the lines converging to the north of Holborn with those entering the Embankment by Blackfriars and Westminster bridges, has been carried out in order that this link in a system of about 165 street route miles, with connections to other systems, which has hitherto been served by single-decker tramcars, may be traversed by the double-decker vehicles of the Council's fleet, so as to allow of long through runs in all directions. The original subway was described in our issue of March 13th, 1908.

The enlargement, for increased headroom, has been accomplished by lowering the rail level on most of the route and raising the roof in the remaining portion. These two main operations have not involved the employment of any notable expedient, nor the provision of any unusual plant, nor has very elaborate

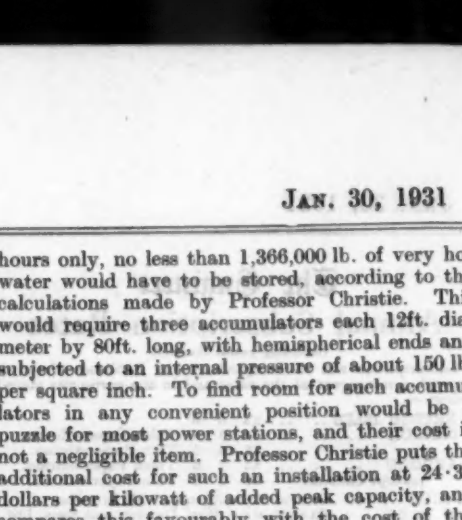


FIG. 1—CROSS SECTION NO. 32 IN FIG. 2

and costly underpinning work been necessary. Nevertheless, the undertaking is interesting, as one demanding the careful planning of operations the nature and sequence of which would provide the shortest adequate period of closure to traffic and the best running facilities consistent with a reasonably low cost. It may be believed that either a design intended to procure any notable improvement in running conditions, or the adoption of measures for reducing considerably the period during which the subway was closed to traffic, would have increased the cost, much and unduly.

The London County Council may, therefore, be congratulated on having adopted the plan of Sir George Humphreys, K.B.E., M. Inst. C.E., its chief engineer, who, after ceasing to occupy that position, was retained as chief engineer for the subway works, no other consulting engineer having been retained.

NATURE OF THE WORKS.

Since a large part of the structural work at the northern end was above the original subway, it was decided to begin from the top and work downwards, under High Holborn, and, in Kingsway, above the Holborn subway station. This work was accomplished within the first six months, while the trams were still running, which left the remaining twelve months for the completion of this work, the lowering of the rail level throughout the route and

the more considerable lowering of the floor in the tunnel under the Strand. Important alterations to the stations were also made.

From rail level on the Embankment there is a short down gradient of 1 in 30, to the entrance of the subway, whence about 30ft. of 1 in 62 brings the new rail level about 2ft. below that of the tramway as previously laid. This amount of lowering, here sufficient, is maintained, on the level, to within about 27ft. of the entrance to the portion of the subway originally carried in two cast iron tubes under the Strand. The roof is there much lower, but, apart from the question of cost it was decided to retain it—the upper portions of the two cast iron tubes—in order that the provision made for a proposed vehicular subway under the Strand might be retained, in case that proposal should be revived.

The Tunnels Under the Strand.

The original cast iron tubes under the Strand, eastern and western respectively, and beginning at the south end, were in straight portions of 39 and 38 rings, followed by east-centred curves of 52 and 58 taper rings, both curves of 168ft. radius, straights of 54 and 57 rings, and short reverse, west-centred curves of 600ft. radius. The outside diameter of these tubes was 15ft. 10in.

At the south end the gradient of entry is 1 in 20 down, the gradient in the tunnel 1 in 83 up, corresponding to the original gradient and about 7ft. lower. At the north end there is a gradient of 1 in 22 up, changing to 1 in 20 to Aldwych West.

The new work and the manner in which the upper portions of the tubes were incorporated, are shown in Fig. 3. The thickness of the middle wall varies from 7ft. to 10ft.; the outer walls are 6ft. thick at the top and 7ft. at the bottom. Timber horse-head frames supported the retained roof portions during the construction of the walls. The lower portions of the tubes were then removed.

In order to maintain adequate support of adjacent structures and of the roadway, the work was carried out in short lengths at a time, the building of the walls preceding the construction of the floor.

The roof segments have been provided with springings, or bases, of cast iron, of 1½in. metal, each giving a bearing 1ft. 6in. by 1ft. 7¾in. The brickwork, between the two middle bases and adjoining the outer bases, is in 3 : 1 cement mortar. The mass concrete is 6 to 1, except in the middle wall, in which it is 8 : 1. The floor is 4ft. 6in. thick at each side of the tramway. Continued up Aldwych West and Kingsway, the work involved underpinning, the foundations of the side walls having to be lowered.

The Tunnel under Holborn.

The conditions at the north end were these. A dip between Holborn Station on the subway and the emergence into Southampton-row had been provided in order to avoid, by passing under them, two cross subways for pipes and cables and an old sewer, in Holborn. This involved an entrance gradient of 1 in 10 and a short reverse gradient, also 1 in 10, up to rail level in the station. This feature has been retained, though modified by a raising of the rail level in the dip by about 3ft. 6in., which shortens the entrance gradient and reduces the reverse gradient from 1 in 10 to 1 in 20. This has been made possible by the additional headroom, resulting from the diversion of the sewer, the invert of which was considerably lower than the floors of the cross pipe subways, which are now supported on steelwork.

The two cast iron tubes in the dip under Holborn have been removed and the roof of the subway is now steel trough decking, immediately underneath the roadway. So much headroom is not, however, required, allowing of the horizontal steel strutting, at about 17ft. above rail level, shown in Fig. 1.

The trough decking rests on 24in. by 7½in., 90 lb. steel joists, which are supported by steel stanchions built into the concrete side walls. The new roof and the roadway on it were constructed before the cast iron tubes were touched. The next operation was to make holes in the tops of the tubes, by removing sections, this allowing of the stanchions being erected, one by one, to the bottom of the excavation and provided with foundations. Thus the whole of the decking was supported by stanchions, before the portions of the tubes between stanchions had been touched. The tubes were then partially removed, the outer segments being left in place.

At the entrance the only substantial alteration is that, owing to the increased headway, on the gradient of 1 in 10, the end of the roof is set back about 25ft. An interesting feature of the subsoil conditions was that water was encountered to the north of the cross pipe subways, but none in the ground to the south of them.

Some Dimensions of the Section North of Holborn Station.

As supplementary to the dimensions given in the figures, the following may be noted :—The old tubes were 16ft. apart, centres ; the new subway is 19ft. 2in., clear width ; the cross pipe subways are 12ft. wide by 7ft. 6in. high ; the centre line of the subway is not quite the same as before. At one cross section the outside of the retained segment—geometrical—of the tube is 6ft. from the face of the wall ; on the other side 8ft. 6in., the recesses in the wall being respectively 2ft. 6in. and 4ft. 9in. deep. The girders supporting the trough decking are 24in. by 7½in., 90 lb., with two 12in. by ½in. flats. The cross struts are 10in. by 8in., 55 lb. The floor is about 4ft. 6in. thick. The stanchions are embedded 15in. in the floor ; each stanchion is one 14in. by 8in., 70 lb., rolled section, with four 14in. by ½in. flats. The base of a stanchion is 2ft. 3in. by 2ft. 6in. The longitudinal struts or stiffeners, embedded in concrete monolithic with the wall, are 10in. by 6in., 40 lb. rolled sections, at 6ft. 9in. below street level. The concrete cover over stanchions is 2in. The internal longitudinal bracings between stanchions, three on each side of the subway, are rolled sections, the lowest in position, over the recesses and the next above, 10in. by 6in., 40 lb.; the upper ones, at about the level of the cross strut, 9in. by 4in., 21 lb. The trough decking is ¼in. metal, with troughs at 1ft. 8in. centres. The diagonal bracing at the cross pipe subways is formed of 10in. by 6in., 40 lb. rolled sections.

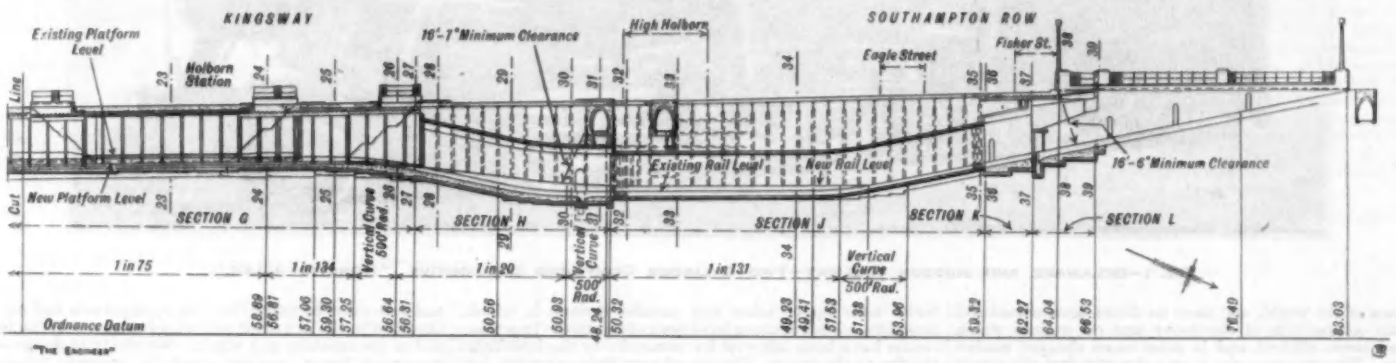


FIG. 2—LONGITUDINAL SECTION OF ENLARGED SUBWAY SHOWING PASSAGE UNDER KINGSWAY

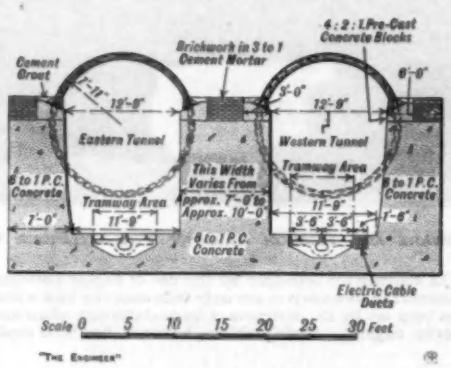

4 : 2 : 1 Pre-Cast Concrete Blocks
Brickwork in 3 to 1 Cement Mortar
Cement Grout
Eastern Tunnel
Western Tunnel
This Width Varies From Approx. 7'-0" to Approx. 10'-0"
Tramway Area
6 to 1 P.C. Concrete
Electric Cable Ducts
Scale 0 5 10 15 20 25 30 Feet
"THE ENGINEER"

FIG. 3—TUNNELS UNDER THE STRAND

Improvement of the Stations.

The stations have been very considerably improved, and the platforms have been lengthened to provide for the great increase in the numbers of tramcars passing through the subway. The former platform height, 18in., has been reduced to 6in., because the footboards of the trams are not adapted for use with platforms, but are designed for the normal conditions with the street surface or the island refuge kerb alongside. Even if platforms, convenient at the subway stations, could be designed, it is better that passengers should enter and leave the trams precisely in the usual manner, in case, during a fog, for instance, a street stopping place might be mistaken for a subway station.

The stations are now agreeably illuminated by flood lighting. By the employment of a kind of mosaic work, each station has been finished in a different colour, the tinting being judiciously distributed and the general effect of the well-defined, but somewhat subdued, tint being decidedly pleasing. This method of distinguishing one station from another should be a convenience to passengers alighting at these stations.

The works were begun in August, 1929, and the formal opening took place on January 15th. The contract price for the whole of the work, carried out by John Cochrane and Co., Ltd., was £171,250.

SIXTY YEARS AGO.

Two items of news in our issue of February 3rd, 1871, suggest that in those days the lot of naval engineers and dockyard officials could, at times, be a hard one. H.M.S. "Black Eagle" left Portsmouth on January 28th for Newhaven to embark Mr. Childers, the First Lord of the Admiralty. Some defect, however, occurred in her engines, and she had to return to port. The defect could not have been very serious, for she again left on the following morning. Nevertheless, because a defect had occurred, the chief engineer was superseded and another engineer officer was arrested to await trial by court-martial. Again, trouble was in store for someone at Sheerness Dockyard, because of the "inefficient way" in which H.M.S. "Torch" had been sent to sea. An inquiry was to be held into the circumstances. If blame could be brought home to any of the dockyard officials, they would be severely reprimanded, and in addition, they would, for their neglect of duty, be required to meet a portion, if not all, of the expenses which would be entailed in bringing the vessel from Plymouth back again to the Medway. . . . There have been many proposals made within recent times for the removal of the Royal Arsenal from Woolwich to some less congested district. The subject was, for instance, debated at some length towards, or following, the end of the Great War, for the Arsenal was clearly seen to be in a position which exposed it to aerial attack. The suggestion that the Arsenal should be removed was not, however, by any means new. It was advanced in the time of Lord Palmerston's premiership, and in the issue quoted above we find that the proposal was again to the fore. The site suggested for the Arsenal was at Cannock Chase. It was argued that so situated the Arsenal would be adjacent to coal mines and to the great ironworks of South Staffordshire and East Worcestershire. The district was well served by the North-Western Railway, it was intersected by canals, and at very little cost could be connected with the Great Western Company's lines. Most of the big engineering establishments which, sixty years ago, had their home in London, or on the river Thames, have gone out of existence, or have migrated elsewhere. Woolwich Dockyard has disappeared as a Government Department. The Arsenal still remains on its original site.

BOOKS RECEIVED.

"*Mechanical World*" *Electrical Pocket Book*, 1931. Manchester : Emmott and Co., Ltd., 65, King-street. Price 1s. 6d. net.

The Plan Requirements of Modern Buildings. By V. D. Rees. London : Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 35s. net.

Manual of Military Vehicles (*I.C. Engined*). London : His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. net.

Ministry of Public Works Annual Report, 1925–26. *Part I.* Cairo : Publications Office, Egyptian Government Press, Bûlâg. Price P.T. 20.

Studies on Industrial Relations, I. International Labour Office Report. London : P. S. King and Son, Ltd., 14, Great Smith-street, S.W. 1. Price 5s. net.

Gas Installations and Appliances and their Efficient Maintenance. By A. T. Gilbert. London : Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 8s. 6d. net.

Brassey's Naval and Shipping Annual, 1931. Edited by Commander C. N. Robinson, R.N., and H. M. Ross. London : William Clowes and Sons, Ltd., 94, Jermyn-street, S.W. 1. Price 25s. net.

Materials and Structures. Volume I.: The Elasticity and Strength of Materials. By E. H. Salmon, D.Sc., M. Inst. C.E. London : Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 15s. net.

Harrison's Business and General Year Book of South Africa and Adjacent Territories. Compiled by C. W. Francis Harrison, F.S.S., F.R.G.S. London : Argus South African Newspapers, Ltd., 72, Fleet-street, E.C. 4. Price 21s. net.

High-Pressure Locomotives.*

By H. N. GRESLEY, C.B.E., Member of Council.

At no time during the history of the steam locomotive have such radical changes been introduced as during the past ten years. These changes have been introduced more or less simultaneously in countries supplying the locomotives of the world, and have no doubt been stimulated by the competition of electricity and oil engines which offered more efficient and in some cases cheaper motive power. Twenty years ago it was thought that the steam locomotive had attained practically its maximum development, as it had nearly reached the limits imposed by the load gauge. The changes necessitated by the adoption of extra high pressures seem to have opened up a new era. Not only do these changes render possible an increase in tractive power, but should at the same time increase the overall efficiency.

In Great Britain alone there are 23,000 locomotives, and a sum of approximately £45,000,000 per annum is spent on their maintenance, renewal, and running. Of this sum, nearly £12,000,000, or 25 per cent., is the cost of fuel burnt by these locomotives, and another £12,000,000 has to be spent on their maintenance and renewal. The purpose of the novel forms of locomotive which have been introduced during the last five years has been to effect economy principally in fuel consumption, but the author wishes to draw attention to the importance of the cost of maintenance, and the necessity for designers of new and improved forms of high-pressure locomotives to remember that the expense incurred in maintaining locomotives is equal to the cost of the great quantity of coal which they consume. It will be seen what a large field there is for economy if both cost of fuel and maintenance can be reduced, and what an influence such economy can have on the cost of transportation on railways.

From the early days of the locomotive it has been recognised that increase of boiler pressure results in decrease of coal consumption, but with the conventional type of locomotive boiler, this has generally resulted in increasing the cost of fire-box repairs, and reducing the life of boilers and fire-boxes. When the "Rocket" was built by George Stephenson, a boiler pressure of 50 lb. per square inch was employed, and pressures have gradually increased until now there are many engines running in this country with a boiler pressure of 250 lb. per square inch. Pressures up to 325 lb. per square inch have been experimentally tried for locomotives in Germany and America, but 250 lb. per square inch can be looked upon as approximately the maximum pressure which can be carried in a boiler of the Stephenson type, having regard to the cost of boiler maintenance.

It has taken 100 years to increase the pressure of locomotives from 50 lb. to 250 lb. per square inch, but during the last five years pressures have leapt up to 450 lb., 900 lb., and now to 1700 lb. per square inch.

The use of pressures above 250 lb. per square inch has necessitated the design of a completely novel form of boiler built up of tubes and circular drums, in which, generally, all flat surfaces have been eliminated. Ingenious means have been adopted for transmitting the heat from the fire to the water. The use of very high pressures, and the consequent high temperature, result in conditions which are much more exacting to the materials used in the construction of the boilers. These conditions are aggravated unless the heat transference is very rapid.

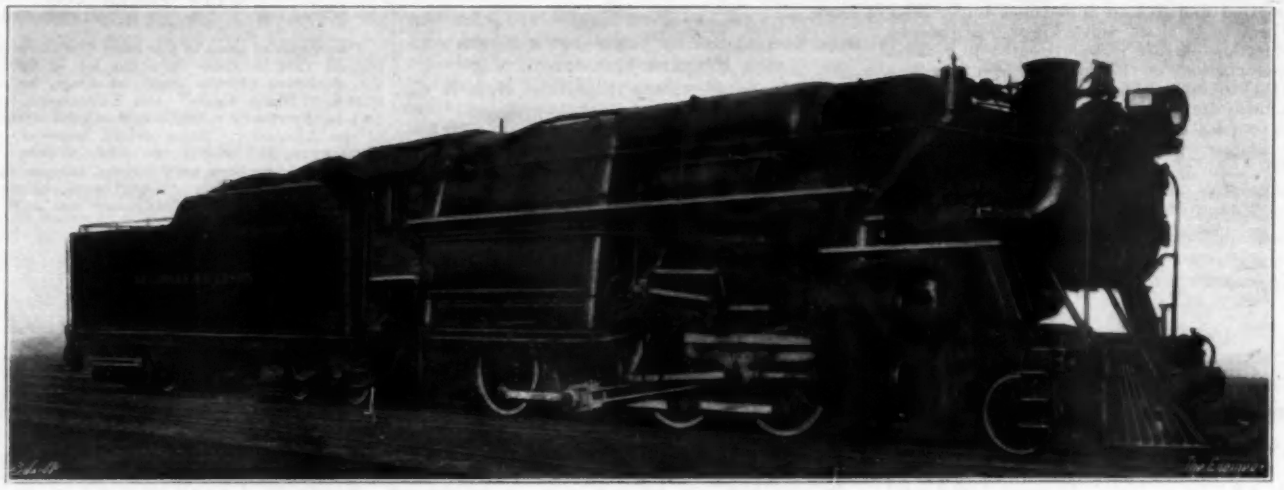


FIG. 1—DELAWARE AND HUDSON RAILWAY—TWO-CYLINDER COMPOUND LOCOMOTIVE, "HORATIO ALLEN."

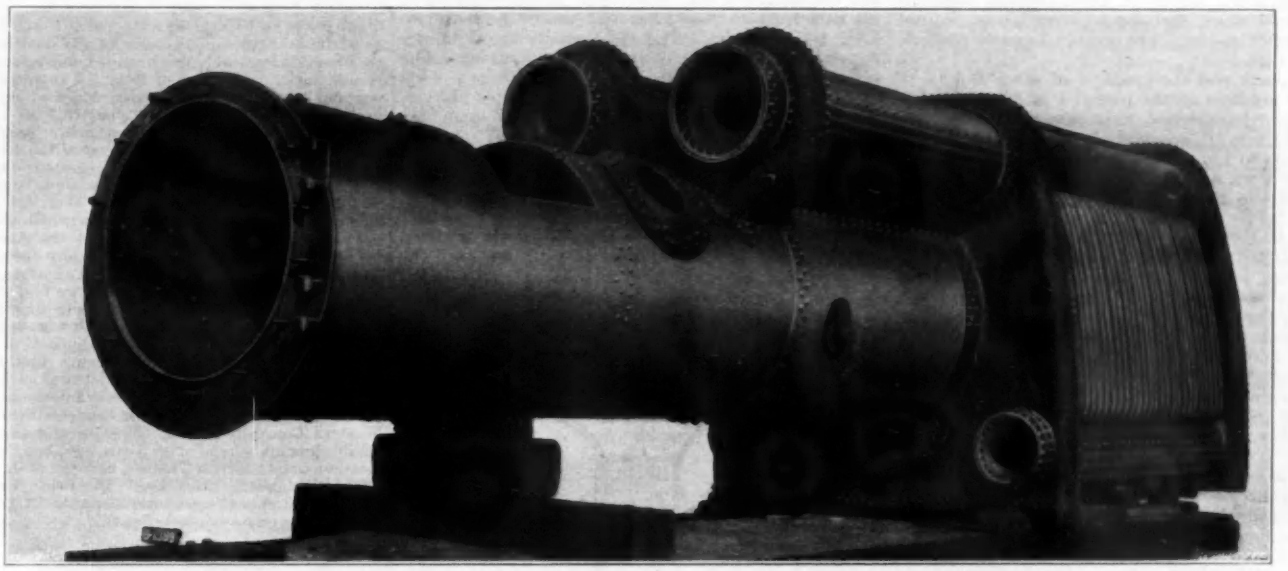


FIG. 2—BOILER OF DELAWARE AND HUDSON RAILWAY TWO-CYLINDER COMPOUND LOCOMOTIVE

In striving for economy by the use of higher pressure, designers of locomotives are only following the lead which has been set by the designers of large stationary plant and marine engines. Their problem, however, has been made more difficult by loading gauge and weight restrictions, and for these reasons they are unable to take advantage of condensers, and have had to extend the pressure gradient upwards to a greater extent. It does not necessarily follow that the use of high pressures in boilers is more dangerous than that of low pressures. An explosion of a boiler at a pressure of 50 lb. per square inch can have disastrous results, and there is no reason, if proper precautions are taken both in design and maintenance, to assume that there is any greater liability to explosion or failure as a consequence of increase in pressure.

Whilst high steam pressure gives greater economy in fuel consumption, it demands complication in design, and care must be taken that the economies in fuel are not absorbed in the increased cost of maintenance of the boiler and of the machine as a whole. Simplicity of design is an important factor, because simplicity generally results in accessibility. Time alone can prove which of the designs, if any, that have been recently produced, will result in such overhead economies as will justify their general adoption. The results which may reasonably be expected from the use of high steam pressures on locomotives are so attractive that encouragement should be given to the production and development of designs by which these results can be attained.

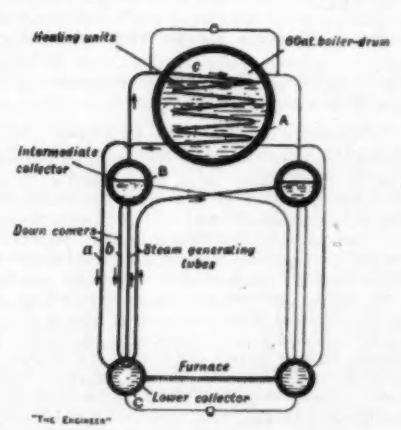


FIG. 3—SCHMIDT-HENSCHEL BOILER

Reciprocating pistons have been adopted in all the latest high-pressure locomotives, as this form of conversion of energy appears to be the most advantageous for meeting all conditions which a locomotive is required to fulfil. Owing to the high range of temperature and the consequent losses by condensation in a simple engine, the use of a compound or "Uniflow" system is essential. It is interesting to note that in the high-pressure locomotives which have been produced during the last five years, both two, three, and four-cylinder compounds have been adopted. The author proposes to describe in some detail the notable high-pressure locomotives which have been produced in America, Germany, Switzerland, and England since 1924.

Delaware and Hudson Two-cylinder Compound Locomotives.—The first of these was built in 1924 by the American Locomotive Company to the designs of Mr. John E. Muhlfeld, for the Delaware and Hudson Railway, and marks the first distinct advance in boiler pressure on a main line locomotive, the pressure being 350 lb. per square inch. The engine was called "Horatio Allen." It is a two-cylinder compound with 2–8–0 wheel arrangement, the tender being fitted with a booster.

The boiler barrel follows usual practice, but over it, on each side, two cylindrical drums are fixed. These extend from the rear end of the fire-box nearly to the front of the boiler barrel. Two shorter drums form the lower sides of the fire-box, the front wall being formed by a flat water space with ordinary stays. The upper drums are connected to this flat water space and pass through it. The boiler barrel is secured to the front wall of the water space. The rear plate of the water space is cut away for the fire-

* The Institution of Mechanical Engineers. The illustrations in this issue are reprinted from back numbers of THE ENGINEER.

box tube plate which is fixed in it, and the front ends of the lower drums are also attached to it. The back end of the fire-box is formed by a similar flat water space into which the rear ends of the four drums are secured.

The top of the fire-box between the top drums is formed by eight horizontal water tubes connecting the front and back water spaces, and each of the sides by six rows of curved water tubes joining the upper and lower drums. The front ends of the upper drums are connected to the boiler barrel by headers, and four pipe connections are also provided. This engine and its boiler are illustrated in Figs. 1 and 2.

With this type of boiler about one-third of the evaporative heating surface is in the fire-box. In ordinary locomotive boilers the fire-box heating surface is only about one-tenth of the total. There is nothing of exceptional novelty about the rest of the locomotive. It must have given satisfaction, because the Delaware and Hudson Railway Company obtained a very similar engine from the American Locomotive Company early in 1927, which was called "John B. Jervis."

The boiler is of very similar construction, but the pressure has been raised to 400 lb. per square inch, and a greater superheating surface given. The fire-box is slightly larger, and it is covered by sheets of heat-resisting steel lagged on the outside, with hand-hole openings to allow ashes to be cleared from the fire tubes and tops of the drums. The brick arch extends the entire length of the fire-box, and causes the gases to flow outwards, and up through the side water tubes into the combustion space above the arch, and to the fire tubes.

The results obtained in advancing by progressive stages having proved satisfactory, the Delaware and Hudson Railway Company, in 1930, produced a third engine, in which the pressure was increased to 500 lb. per square inch, which was named "James Archbald." This engine has a boiler of the same type as the previous engines, but its external appearance is noticeably different, the boiler being enclosed by an outside casing, which effectively insulates and stream-lines the upper part. The superheating surface has been considerably increased, giving a steam temperature of 700 deg. to 750 deg. Fah.

The main dimensions of these three locomotives are given in Table I.

TABLE I.—*Delaware and Hudson High-pressure Locomotives.*

	"Horatio Allen."	"John B. Jervis."	"James Archbald."
Date built	1924	1927	1930
Grate area, sq. ft.	71·4	82	82
Heating surface :—			
Fire-box, sq. ft.	1,187	1,217	1,114
Total evaporative, sq. ft.	3,200	3,121	3,439
Superheater, sq. ft.	579	700	1,037
Boiler pressure, lb. per sq. in.	350	400	500
Cylinders :—			
Diameter H.P., in.	23½	22½	20½
,, L.P., in.	41	38	35½
Stroke, in.	30	30	32
Driving wheel diameter, in.	57	57	63
Adhesive weight, tons	133	132	134
Total weight of engine	156	150	159
Tractive force :—			
Simple, lb.	84,300	85,000	85,800
Compound, lb.	70,300	70,800	71,600

The Schmidt-Henschel Three-cylinder Compound Locomotive.—In 1926 one of the standard three-cylinder 4–6–0 engines of the German State Railways was converted by Messrs. Henschel and Sons, of Cassel, into a high-pressure locomotive. This engine was fitted with a multi-pressure type of boiler built to the design of the Schmidt Superheater Company, in which steam was produced at a pressure of 850 lb. per square inch by means of a closed circuit in which the heat transfer medium was distilled water. The design was the result of the invention and many years' investigation of the late Dr. Schmidt. A full description of this engine was given by Mr. R. P. Wagner, Chief Engineer of the German State Railways, before the Institution in 1927, and only a brief account of the principle of its operation, therefore, is given in this paper.†

In this system, the tubes forming the walls of the fire-box are filled with distilled water. They are subject to direct radiant heat, and owing to the purity of the water, there is no corrosion or scaling to cause overheating of the tubes. The principle is illustrated diagrammatically in Fig. 3. The steam is generated in the fire-box tubes at a pressure of 1200 lb. to 1600 lb. per square inch, the pressure depending on the rate of firing. The steam passes through separating drums to the heat-transfer elements, situated in the high-pressure drum. The difference in temperature between the saturated steam of 1200 lb. to 1600 lb. pressure in the heat-transfer elements, and the water in the high-pressure drum at 850-lb. per square inch pressure, causes the latent heat in the steam to evaporate the water. The steam in the closed circuit is condensed by the removal of its latent heat and returned as water by way of the down-pipes to the fire-box bottom ring.

The boiler consists of two sections; one section generates the high-pressure steam at 850 lb. per square inch in a high-pressure drum by means of the closed circuit, as described above, and the other section, which is similar to the barrel of an ordinary locomotive boiler, produces steam at about 200 lb. per square inch pressure. The high-pressure drum is a solid forging of about 3ft. internal diameter, and is protected from the direct heat of the fire-box gases by the cross-over tubes and by steel protection plates covered with asbestos sheets. The heating elements are inserted into the drum through a manhole at the rear end and consist of pipes 1¼in. diameter arranged in groups of coils. The inlet on each element is connected to the separator drums and the outlet to the fire-box ring.

The low-pressure boiler has flues 3¼in. outside diameter and nearly all these contain superheater elements. The flues at the top contain the low-pressure elements, and those at the bottom, elements for high-pressure steam. The water from the tender is fed into the low-pressure boiler by ordinary injectors or feed pumps. The feed for the high-pressure drum is delivered by a pump from the low-pressure boiler, the water being at a temperature of 390 deg. Fah., which is the saturated steam temperature of the low-pressure boiler; consequently, most of the solid matter in the water has been deposited in the low-pressure boiler.

In operation, superheated steam from the high-pressure boiler enters the centre cylinder and exhausts into a receiver, where it mixes with superheated steam from the low-pressure boiler, the combined steam passing to the low-pressure cylinders and so to the blast-pipe. The operation of the locomotive is similar to one of ordinary type, as the two regulators are coupled together and the reversing gear is controlled by one lever.

The locomotive was delivered in 1926, and after several minor alterations, was put into ordinary service and has given satisfactory results. Before being put in regular service, it was subjected to a series of comparative trials with locomotives of the standard three-cylinder simple type, as used for express trains on the German State Railways. The coal consumption per draw-bar horse-power hour of the Schmidt engine was about 2·5 lb., and the steam consumption about 18 lb.

Since then, certain modifications have been made, resulting in further reduction of fuel and steam consumption to 2·15 lb. and 15 lb. respectively, giving an economy of 35 per cent. in fuel and 23 per cent. in steam, as compared with engines of the standard type. The calorific value of the fuel used was approximately 12,600 B.Th.U. per pound.

The proportion of the total power supplied by the high-pressure boiler at low output is 65 per cent. and at higher output falls to 55 per cent. As the remainder of the steam is formed at ordinary boiler pressure, it is now appreciated that greater savings will be possible if a greater proportion can be generated at the higher pressure. In the latest designs the ratio has consequently been altered, the function of the low-pressure boiler becoming mainly that of a preheater and supplying only a very small proportion of the low-pressure steam.

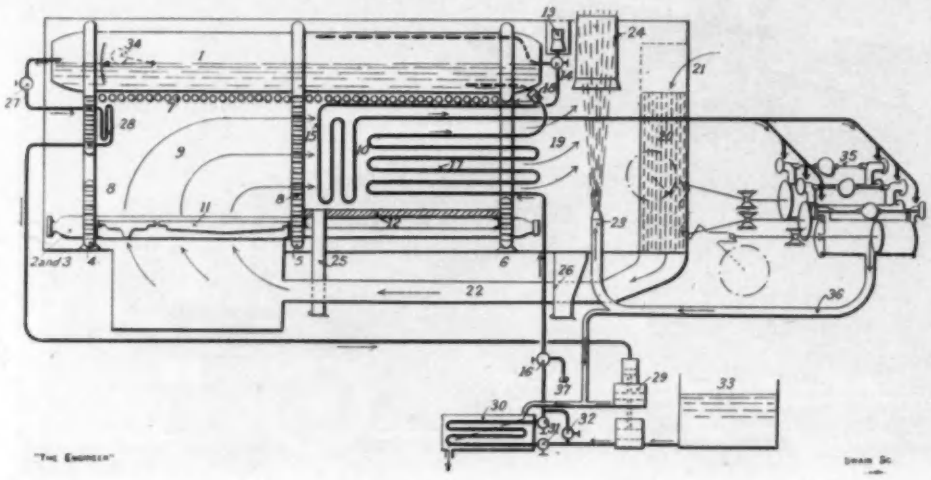
During last year a locomotive having a boiler of this type was built by the North British Locomotive Company, of Glasgow, for the London, Midland and Scottish Railway Company, and later on in the year another of these engines was built by Messrs. Henschel and Sons for the Paris, Lyons and Mediterranean Railway of France. Engines having boilers of this type are at present under construction for the Canadian Pacific Railway and the New York Central Railway. Table II. gives the leading dimensions, so far as at present available, of locomotives equipped with Schmidt high-pressure boilers.

TABLE II.—*Comparative Data of Schmidt Multi-pressure Locomotives.*

Railway	German State Rly.	L.M.S.	N.Y.C.	C.P.R.	P.L.M.
Type	4–6–0	4–6–0	4–8–4	2–10–4	4–8–2
Fuel	Coal	Coal	Coal	Oil	Coal
Grate area, sq. ft.	26·6	28	70	77	41
High-pressure Boiler—					
Heating surface :					
Fire-box, sq. ft.	217·6	—	422	515	323
Heat transfer elements, sq. ft.	426	368	660	750	407
Superheater ,,	430	274	—	—	507
Boiler pressure, lb. per sq. in.	850	900	850	850	850
Low-pressure Boiler—					
Heating surface :					
Flues, sq. ft.	1,265	1,335	3,229	3,746	1,680
Superheater, ,,	426	355	—	—	525
Boiler pressure, lb. per sq. in.	205	250	250	250	200
High-pressure Cylinder—					
Diameter, inches	11·4	11·5	13	15·5	9·5
Stroke, inches	24·8	26	30	28	25·6
Low-pressure Cylinders—					
Diameter, inches	19·7	18	23	24	22
Stroke, inches	24·8	26	30	30	27·5
Driving wheel diameter, inches	78	81	69	63	70·8
Weight of engine, tons	91	89·3	181	206	115
Tractive effort, lb.	—	33,200	66,000	83,300	—

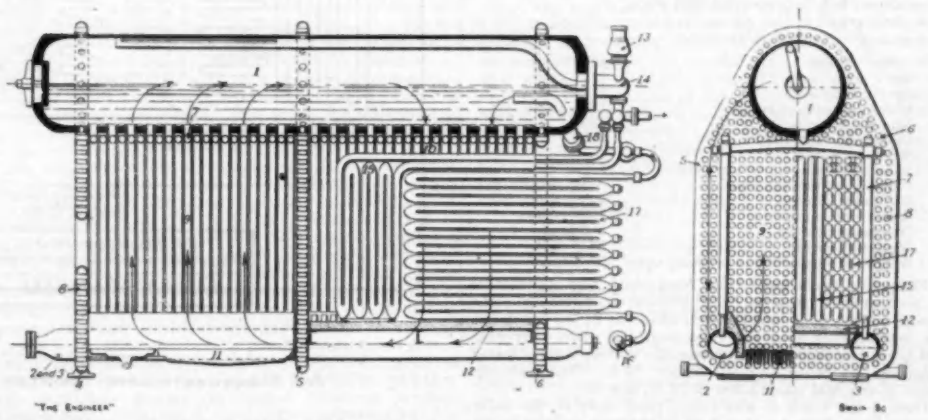
Winterthur High-pressure Locomotive.—The Swiss Locomotive and Machine Company, Winterthur, completed a 2–6–2 tank locomotive about the end of 1927, to the designs of Mr. Buchli, their chief engineer, in which the steam is generated in a boiler of the water-tube type, carrying a working pressure of 850 lb. per square inch.

The general principle is illustrated in Fig. 4. The boiler is fed by a compound feed pump, its steam supply passing through a small superheater in the fire-box. The feed-water is preheated by exhaust steam to a temperature of



1. Steam-drum.
2, 3. Bottom drums.
4, 5, 6. Water walls.
7. Water tubes.
8. Stay tubes.
9. Fire-box.
10, 12. Combustion chamber.
11. Grate.
13. Safety valve.
14. Regulator.
15, 28. Superheaters.
16, 27, 31, 32. Stop valves.
17, 18. Main feed-heater and delivery.
19, 24. Smoke-box and chimney
20, 21, 22. Air heater and dust.
23, 36. Exhaust pipe.
25, 26. Ash outlets.
29. Feed pump.
30. Feed preheater.
33. Tank.
34. Water gauge.
35. Engine.
36. Drain.

FIG. 4—WINTERTHUR HIGH-PRESSURE LOCOMOTIVE



1. Steam drum.
2, 3. Bottom drums.
4, 5, 6. Water walls.
7. Water tubes.
8. Stay tubes.
9. Fire-box.
10. Combustion chamber.
11. Grate.
12. Refractory floor.
13. Safety valve.
14. Regulator.
15. Superheater.
16, 18. Non-return valves.
17. Main feed-water heater.

FIG. 5—WINTERTHUR HIGH-PRESSURE LOCOMOTIVE

† This engine was fully illustrated and described in our issue of January 20th, 1928.—ED. THE E.

about 180 deg. Fah., and is then pumped through the feed heater situated in the front of the boiler, where its temperature is raised to about 450 deg. Fah. The air to the grate passes through a heater situated at the front of the smoke-box. The engine is totally enclosed and has three simple cylinders, the cranks being set at 120 deg. It is fitted with cam-operated poppet valves, and is of the "Uniflow" type, having exhaust passages at the centres of the cylinders. The single-seated poppet valves allow of the use of a higher degree of superheat than would be possible with piston valves, and the high revolution speed and "Uniflow" principle also assist in preventing excessive temperature drop during expansion.

The cam shaft is operated by means of bevel gearing from the crank shaft, and different rates of cut-off and reversal are obtained by moving the cam shaft transversely to bring other cams into engagement. When the locomotive is coasting the valves can be lifted off their seats to prevent compression. The crank shaft is geared to the jack shaft by means of a 2½ to 1 flexible reduction gear. The rods transmitting power to the coupled wheels are attached to the centres of the leading coupling rods, thus limiting the effect of angularity.

The boiler is illustrated in Fig. 5. It consists of a top drum which acts as a steam reservoir, and two small bottom drums. The drums are connected together by the water space walls. These walls are pierced by a number of short tubes which allow the furnace gases to pass through. The water-tube elements consist of two vertical tubes secured at their lower ends to the two lower drums. Their upper ends are joined by a cross tube which in turn communicates with the upper drum by means of a T-piece. The space between the rear and centre water walls is fitted with a grate and forms the fire-box. The superheater is situated at the rear of the front section and communicates with the header which is on the engine side of the regulator. The main feed-water heater is situated in front of the superheater and is fitted with end caps to allow of the removal of scale.

Before assembly, the various components of the boiler were subjected to exhaustive experiments in order that adequate factors of safety should be obtained. For example, the water walls were subjected to a steam pressure of 2800 lb. per square inch. The tube elements were also subjected to rigorous tests, and the complete boiler was used for some time as a stationary boiler so that the various accessories could be experimented with.

A photograph of this locomotive is reproduced in Fig. 6, and its main particulars are given below :—

Boiler pressure	850 lb. per sq. in.
Grate area	14·4 sq. ft.
Heating surface	215 sq. ft.
Water capacity of boiler	594 gallons
Number of cylinders	Three
Diameter of cylinders	8½in.
Stroke of piston	13½in.
Ratio of gear wheel transmission	1/2·5
Diameter of driving wheels	60in.
Maximum speed	50 miles per hour
Water tank capacity	1320 gallons
Coal tank capacity	2·7 tons
Weight of locomotive, empty	62·8 tons
Weight of locomotive in working order	90·8 tons

Extensive trials have been made with this locomotive in Switzerland, Austria, and France, and during some recent trials a coal consumption of about 2½ lb. per draw-bar horse-power hour has been recorded when delivering 800 horse-power at the draw-bar, the corresponding water consumption being slightly under 15 lb. The calorific value of the coal was 13,500 B.Th.U. per lb.

During the trials it was found that most of the solid matter contained in the feed-water was deposited in the feed-water heater, but some trouble has been experienced by the formation of scale in the boiler tubes. The makers are taking steps which they expect will prevent this in future. It will be seen from the list of dimensions that the locomotive is only of small size. With a larger locomotive it is expected that considerably better results could be obtained.

Schwartzkopff-Loffler Three-cylinder Locomotive.—In April, 1930, an engine was completed to the order of the German State Railways by the Berlin Machine Works, formerly known as Messrs. L. Schwartzkopff and Co., constructed to the designs of Dr. Loffler, in which a pressure of 1700 lb. per square inch is used. This engine is a three-cylinder engine, having two high-pressure and one low-pressure cylinder.

As will be seen from Fig. 7, the principle on which the boiler is designed is entirely different from that of any locomotive which has previously been built. Whereas in the Schmidt engine distilled water is used as a medium for transmitting the heat from the fire to the water from which steam is generated, in this case the medium of transfer is steam highly superheated in tubes forming the walls of the fire-box. Steam in a saturated condition is drawn from the high-pressure drum by means of a circulating pump, and is forced through the superheater tubes referred to above, in which it becomes superheated to a temperature of about 900 deg. Fah., and the pressure raised to approximately 1700 lb. per square inch. About one-quarter of this steam is used for supplying the high-pressure cylinders, and the remaining three-quarters is returned to the high-pressure evaporating drum. This raises the temperature of the water in the drum, and the steam so generated passes again to the circulating pump for superheating as described above. The exhaust steam from the high-pressure cylinders passes first through an oil separator, then through the feed-water heater from which the low-pressure boiler is supplied, and thence through tubes in the low-pressure boiler, in which pressure up to about 225 lb. per square inch is generated. The condensate from the high-pressure exhaust passes to a feed-water tank, whence it is pumped back to the high-pressure drum through the high-pressure feed-water heater, any leakage in steam in the high-pressure system being made up from the low-pressure boiler. Steam generated in the low-pressure boiler passes through another superheater, in which it is raised to a temperature of about 640 deg. Fah., from whence it passes to the central low-pressure cylinder, and is finally exhausted up the blast-pipe.

In addition to supplying the low-pressure cylinder, the low-pressure boiler supplies steam for operating all the pumps. The pumps are in duplicate, a set being situated on each side of the engine. Each set consists of three pumps—(1) the circulating pump for circulating steam from the high-pressure evaporative drum through the superheating tubes forming the fire-box; (2) the pump feeding the high-pressure evaporative drum with the condensate from the high-pressure exhaust; and (3) the pump feeding the evaporative drum with the make-up water from the low-pressure boiler. Each of the pumps is capable of delivering about 75 per cent. of the maximum requirements of the boiler, and absorbs about 4 per cent of the power developed. In order to improve the efficiency of the engine, the air supply to the fire-box is preheated to a temperature of 300 deg. Fah.

From an examination of Fig. 7 it will be seen that the heat generated in the fire-box is utilised first of all to superheat the steam for the high-pressure cylinder and the evaporative drum. The gases then pass through a nest of tubes raising the temperature of the steam supplied to the low-pressure cylinder, thence through the high-pressure feed-water heater, after that the air preheater, finally passing up the chimney.

The two outside high-pressure cylinders are machined from steel forgings carried in cast steel brackets bolted to the frame. They are free to expand in this bracket in a longitudinal direction to avoid stresses. Owing to the small size of the cylinders, tail rods have had to be provided to equalise the power on the forward and backward strokes. Steam is distributed to the cylinders by piston valves, and in all other respects the construction of the motion, frames, &c., is similar to that employed by the German State Railways.

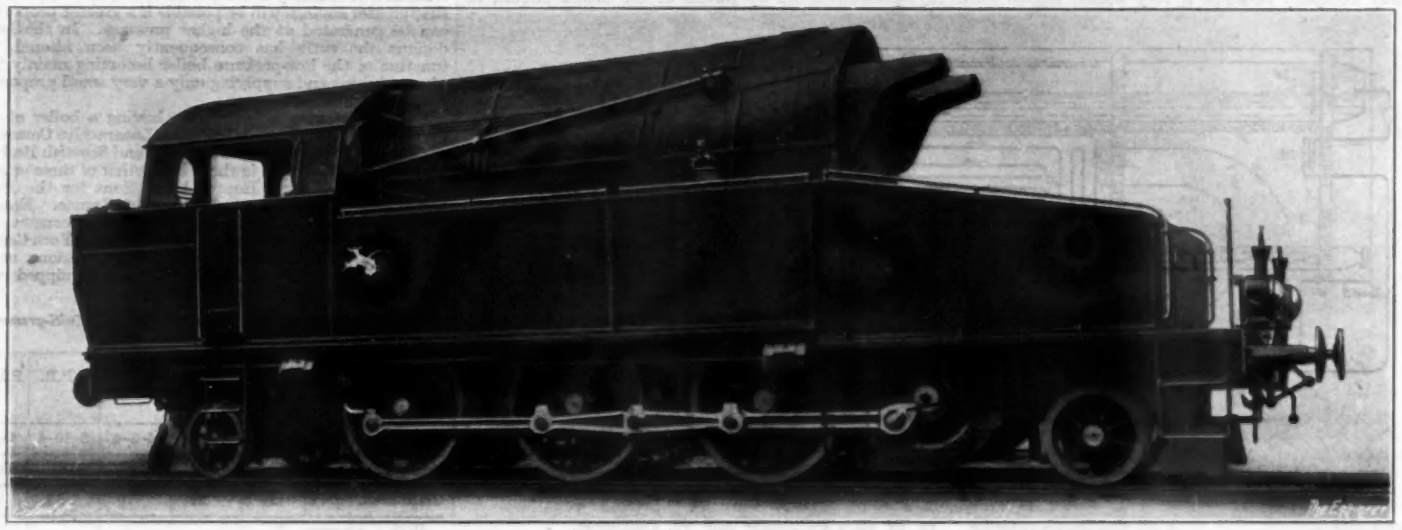


FIG. 6—WINTERTHUR HIGH-PRESSURE LOCOMOTIVE

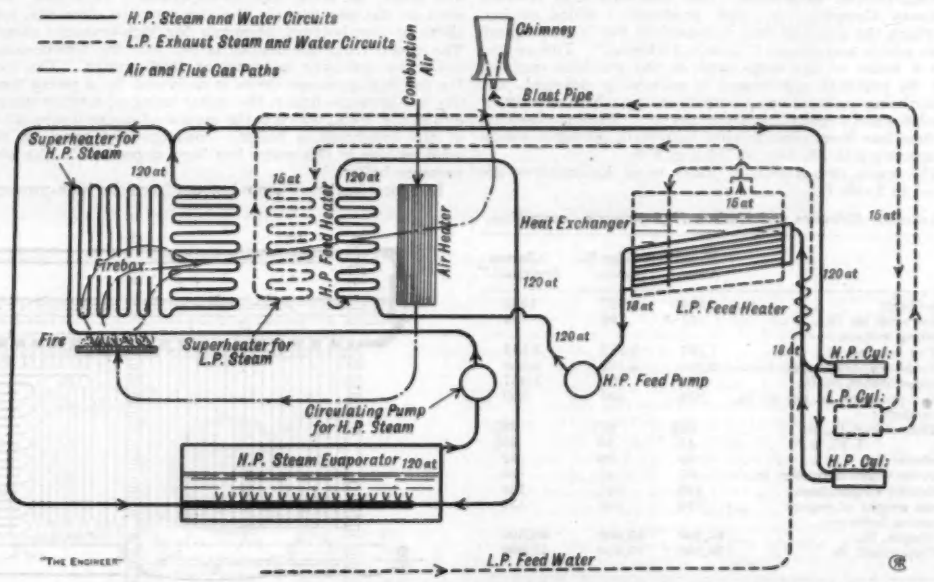


FIG. 7—SCHWARTZKOPFF-LOEFFLER THREE-CYLINDER COMPOUND LOCOMOTIVE

The author has described only the main principles of the Loffler locomotive, but whilst no doubt every effort has been made to utilise as far as possible the heat generated in the fire-box, it must be admitted that this has only been effected by a very intricate and complicated system of tubes and drums. It will be appreciated also that the design involves the use of a very large number of joints and connections, a failure of any one of which might have serious results. Another serious drawback to this locomotive is that steam can only be raised if a steam supply from another source is available for the initial heating up of the water in the high and low-pressure steam generators. The pressure in the latter must rise to about 70 lb. per square inch before the pumps can be started, and until then the fire cannot be lit in the grate. It is usually convenient to obtain this steam from another locomotive. The most important feature, however, in connection with the working of the engine is the necessity for absolute reliability in the circulating and feed pumps, and this, no doubt, is the reason why the designer has thought fit to duplicate this feature in the engine.

In the Loffler boiler there is no necessity to use distilled water, ordinary feed-water being quite satisfactory, because the concentration and deposit of scale is only possible in the high-pressure evaporative drum which is not heated by either fire or high-temperature circulating tubes, as in the case of the Schmidt boiler. Boiler scale will therefore have no injurious effect.

Special precautions have been taken to ensure safety as far as possible. Non-return valves are situated in the high-pressure steam and feed-water pipes, so that in the event of a superheater pipe bursting, the high-pressure drum is isolated, and only the steam in the superheater can escape. Safety devices have also been incorporated for rapidly

THE SCHWARTZKOPFF-LOEFFLER THREE-CYLINDER COMPOUND LOCOMOTIVE

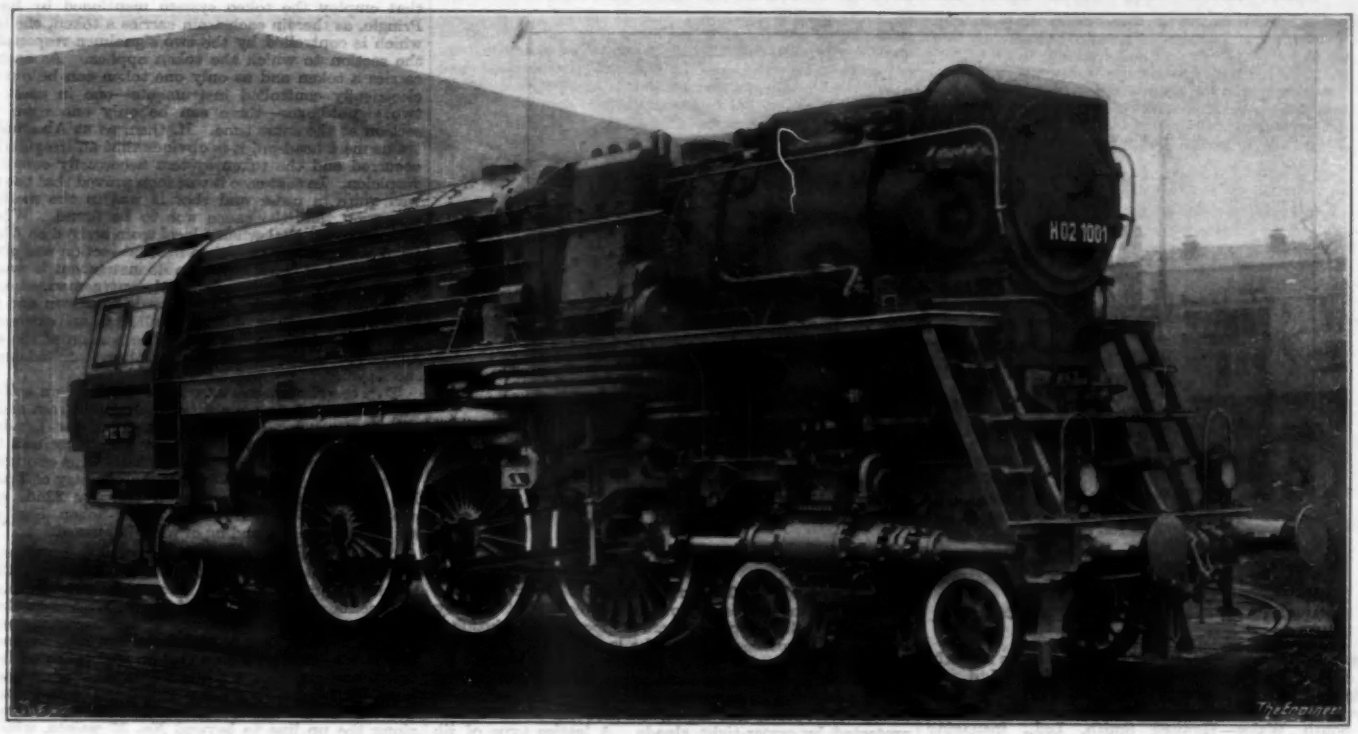


FIG. 8

reducing the fire-box temperature in case of pump failure.

It is claimed that with this locomotive a fuel economy of 45 per cent. will be attained, and its overall thermal efficiency will be raised to nearly 18 per cent. It is difficult to reconcile these claims, as an efficiency of 18 per cent. is more than double that of an ordinary locomotive. Trial runs have been made with this locomotive, but the author has not been supplied with the actual results obtained. A photograph of this locomotive is reproduced in Fig. 8, and its main dimensions are given below :—

Grate area	26 sq. ft.
Heating surfaces—	
High-pressure superheater	970 sq. ft.
Low-pressure superheater	344 sq. ft.
High-pressure preheater	764 sq. ft.
Low-pressure boiler	882 sq. ft.
Boiler pressures—	
High-pressure boiler	1700 lb. per sq. in.
Low-pressure boiler	215 lb. per sq. in.
Motion—	
Diameter of high-pressure cylinders	8¼in.
Stroke of high-pressure cylinders	26in.
Diameter of low-pressure cylinder	23½in.
Stroke of low-pressure cylinder	26in.
Diameter of driving wheels	78¾in.
Diameter of bogie wheels	33½in.
Diameter of trailing wheels	49½in.
Weight empty, calculated	110 tons
Weight in working order, calculated	113 tons
Adhesive weight	59 tons

(To be continued.)

High Voltage Testing.

Two exceptionally interesting papers, from the point of view of those who have to deal with insulation problems, were read on Thursday, January 22nd, before the Institution of Electrical Engineers—one on "High-voltage Testing Equipments," by Messrs. E. T. Norris and F. W. Taylor, and the other on "Dielectric Phenomena at High Voltages," by Messrs. B. L. Goodlet, F. S. Edwards and F. R. Perry. The chief objects of the former paper are to describe the state of the art of high-voltage generation, to assist intending purchasers of high-voltage testing equipments in deciding upon the best type of apparatus to install, and to help owners and operators of existing apparatus to appreciate the possibilities and limitations of their apparatus, and thereby make full and efficient use of it. The principal components of a high-voltage testing equipment are considered, especially with regard to the various purposes for which testing equipment may be required, and the suggestions are illustrated by descriptions of complete standard testing equipments for various purposes. Finally, the design and layout of large comprehensive high-voltage laboratories are discussed with the help of illustrations of existing modern equipments.

It is shown that there are several forms of high potential, each having its particular application and field of use—(*a*) sustained low frequency; (*b*) constant D.C.; (*c*) high frequency, and (*d*) surge, or impulse. The first is by far the most common form of high voltage, and apparatus for producing it is part of practically every high-voltage testing equipment. Most electrical machinery and apparatus works at 50 or 60 cycles, so that it is natural to use the working and higher voltages at the same frequency for testing and experimental work. Apart from purely scientific and experimental work, the chief uses of constant D.C. are in the study of insulation characteristics, particularly absorption and resistance, and in tests and experiments on apparatus of large electrostatic capacitance, such as cables, which, with low-frequency A.C., would necessitate very large and expensive testing equipment. High-voltage D.C. testing equipments are shown to be confined almost entirely to the routine testing of cables on site, where portability of the testing equipment is an important factor. Since they can be used for fault localisation, the demand for them is considerable, and it has grown rapidly within recent years.

Now that it is realised that even momentary oscillatory surges are comparatively rare, there is less use for high-frequency testing equipments than there was in the past. The demand and use of high-voltage surge or impulse generators, on the other hand, is shown to have increased enormously within the last few years for two principal reasons. The experimental investigations of transient disturbances on transmission lines owing to lightning, switching and other causes, has shown that the most frequent and most dangerous type of disturbance is a travelling wave of steep wave front, usually non-oscillatory, but alternatively heavily damped. When a surge of this type enters a power transformer at the end of a line the voltage is not distributed uniformly throughout the winding, but concentrates at certain parts and causes excess stresses out of proportion to the amplitude of the surge. Experience has shown that these stresses seriously affect the working life of the transformer, and are, indeed, the most frequent cause of ultimate breakdown, with the result that it has become of great importance to study the effects of surges on insulation. The essential part of a surge generator, the authors explain, is an electrostatic condenser, or series of condensers, which can be charged up to the required high voltage and then discharged through a circuit having electrical constants depending on the type of discharge required. In this elementary form a rectified alternating voltage at least as great as the highest condenser voltage is required, and for surges with a maximum amplitude exceeding 200,000 volts the rectification is expensive and complicated. The difficulties have, however, been completely overcome by a method devised by Dr. Marx, of Brunswick, in accordance with which a number of condensers are charged up in parallel through resistances, and when a predetermined voltage is reached the condensers are automatically connected in series through spark gaps.

The descriptions in the paper of the various high-tension laboratories make very interesting reading, and cannot fail to appeal to engineers engaged on high-voltage testing work. Considerable attention is paid to voltage regulating apparatus, and the opinion is expressed that whilst alternator field control is the most expensive method of voltage regulation, it is the best. This opinion appeared to be shared by some who took part in the discussion, which seemed to indicate that the induction regulator method is not always satisfactory on account of wave form distortion. It is pointed out in the paper, however, that wave form distortion by induction regulators depends very much on the type, size and design, and that large regulators having distributed windings produce less distortion than small regulators employing shuttle type windings. Other methods of voltage regulation discussed in the paper are the tapped transformer and resistance methods. Attention is also paid to low-tension switchgear and connections, overload protection, minimum voltage, over-voltage protection, high-tension connections and high-tension protective devices.

The paper on "Dielectric Phenomena at High Voltages," by Messrs. B. L. Goodlet, F. S. Edwards and F. R. Perry, discusses the breakdown of air, oil and solid dielectrics by normal frequency, impulsive and high-frequency voltages, and gives a large amount of original numerical data, covering the entire range of pressure up to one million volts. The scope of the paper cannot be explained in a few words, for the work reported on covers a very wide field. When starting up a large high-voltage laboratory some years ago, the authors were struck with the heterogeneity of published information and determined that work should not be carried out merely on the dictates of expediency, but, as far as possible, in accordance with a reasoned survey of the whole field under review, and the paper gives the preliminary results of the authors' investigations. The authors point out that the problems arising in insulation design are, in principle, very similar to those attacked by that branch of engineering science known as the strength of materials, and that in both cases engineers are concerned with the interactions occurring between two sets of variables. Among many other interesting facts brought to light in the paper is that peculiar effects are sometimes met with, as shown by the following example. With a 75 cm. sphere observations of sparking voltage were made with a gap length of 96in. between sphere and plane. The mean value of shots was 803 kV (eff.). Another sphere 25 cm. in diameter was then introduced into the gap, standing on a pedestal and connected to earth, the distance between the two spheres being 48in., or half the original gap. The mean spark-over voltage from a number of observations was 800 kV (eff.), i.e., practically unaltered. Another paradox is also worthy of mention. It has long been known that brush discharges do not occur from needle points the angle of which is very small, and that the sparking voltage of a needle gap is increased considerably when the angle of the needles is reduced below a certain value. In laboratory work, engineers have also frequently expressed their astonishment at the small amount of discharge proceeding from very fine wires compared with the long brushes on the larger objects to which these wires are connected. Again, continental engineers have long used guard-rings cut with very sharp edges to increase the spark-over voltage of bushing and pedestal insulators, and such knife-edge electrodes are sometimes very much more effective than the large curved shields prescribed by classical theory. From the tests on this phenomena carried out by the authors only one example can be given here. The special electrode used consisted of a brass cylinder 7½in. external diameter, with a ¼in. wall and 15in. long, bored out at one end to form a sharp edge with a taper of 1 in 4, and this electrode was suspended above a flat disc electrode. The increase brought about by the sharp edge was so appreciable that the arc passed from the upper end of the cylinder, thereby traversing a path exceeding by 15in. the shortest distance between the electrodes, the spark-over voltage being 435 kV (eff.).

CERTIFICATES AND DIPLOMAS IN ENGINEERING.

THE Joint Committee of the Institution of Electrical Engineers and the Board of Education for National Certificates and Diplomas in Electrical Engineering (England and Wales) reports that the results for the last three years have been as follows :—

	1928.	1929.	1930.
Ordinary certificates awarded	361	433	510
Higher certificates awarded	149	205	227
Post-higher certificates awarded	6	4	3
Ordinary diplomas awarded	8	10	20
Higher diplomas awarded	6	4	4
Total number of successful students	530	656	764
Total number of failures	339	428	442

THE Edison Medal has been awarded to Dr. F. Conrad, of the Westinghouse Electric and Manufacturing Company, Pittsburg.

COAL-CARRYING STEAMER "CALDARE"

JOHN LEWIS AND SONS, LTD., ABERDEEN, BUILDERS AND ENGINEERS

Collier with Grab Cranes.

THE twin-screw steamer "Caldare," which has recently been constructed by John Lewis and Sons, Ltd., of Aberdeen, for the Newcastle and Sydney coal trade of Australian Steamships Proprietary, Ltd., of Sydney, New South Wales—Howard Smith, Ltd., managing owners—is noteworthy on account of her special installation of grab cranes, which were designed and supplied by John M. Henderson, Ltd., of King's Works, Aberdeen.

The operating conditions for which the steamer was designed are somewhat unusual, as the discharging depots are in some instances situated at shallow water berths. On that account the ship had not to exceed a normal draught of 10ft. 6in., and for that and other reasons a twin-screw arrangement of propelling machinery was chosen. As coal-discharging plant is not available at many of the shore stations at which the ship calls, it was decided to equip the vessel with two grab cranes

UNLOADING COAL AT A WHARF

of special marine design. The height of discharge required was at least 40ft. above the water line of the ship, and the grabs were required to deliver the coal at a distance of not less than 20ft. clear of the ship's side. With the jibs of both cranes swung at right angles to the centre line of the ship, the crane makers were called upon to guarantee that the vessel would not heel more than 4 deg. when in a light condition, or more than 3 deg. when loaded. These requirements, we learn, were fully complied with in the recent tests.

The principal dimensions of the "Caldare" are as follows:—Length between perpendiculars, 165ft.; breadth, moulded, 36ft. 6in.; depth, moulded to the upper deck at the side, 13ft. 3in.; cargo and bunker deadweight carrying capacity on a 10ft. 6in. draught, 500 tons; designed sea speed, 10½ knots. The propelling machinery consists of a standard installation of twin-screw, triple-expansion engines, and 160 lb. pressure boilers, all supplied by the builders.

The two views reproduced above were taken during the recent trials of the ship in Aberdeen.

The two cranes each have a lifting capacity of 3 tons, with a maximum radius of 38ft. 6in. and a minimum radius of 12ft., and they are each designed for an output of 60 tons of coal per hour. The arrangement of the cranes is such that each crane serves one of the two coal holds. They are of the pillar type and are supported in phosphor bronze ball-pivot bearings on the lower deck, the pillars being restrained with regard to their side movement by horizontal roller paths on the upper deck. The pillars, which are shown in our lower illustration, are built up of caulked steel plates and angles, and the roller paths are also protected by water-tight glands. A lattice type of jib is employed, which is curved at the outer ends in order to give sufficient clearance for the grabs at the highest point of lift. A special type of four-rope grab shown above was supplied by William Goodacre and Son, Ltd., of London, which has a low centre of gravity and a small overall height. These grabs are designed to work on a slope and will easily pass underneath the hatch coamings. The crane machinery is arranged below deck, so that it should not suffer damage either from sea water or from the coal.

Separate engines are arranged in a water-tight compartment below the deck for the three operations of hoisting and grabbing, derricking and slewing. The operation and reversing of each engine is carried out by a single lever, placed on the front of the operator's platform, which, as will be seen from the view alongside is placed high up at one side of the pillar, so that the operator has an unobstructed view of his work. Steam can be used at the normal boiler pressure of 160 lb. per square inch, but is usually reduced to 100 lb. pressure. Arrangements are made to lift or lower the grabs in either the open or closed positions, and a slipping clutch is included in the train of slewing gears in order to prevent shock when starting or stopping. The derricking motion is derived from worm gear running in an oil bath. For the crane machinery, machine-cut mild or cast steel gears are employed with gun-metal rimmed worm wheels and hardened steel worms.

The working of the cranes we have described was fully tested on the ship at the builders' yard, and after the drivers had become accustomed to the various motions, it was shown that they were easily capable of handling the specified hourly capacity of coal. The speeds for the various motions are as follows:—Hoisting, 200ft. per minute; derricking, 100ft. per minute, and slewing, 1¾ to 2 revolutions per minute, against a maximum angle of careen of 6½ deg. These speeds were somewhat exceeded during the trials referred to. When at sea the crane jibs are lowered and are supported on portable gantries, the grabs also being stored in positions specially prepared for them.

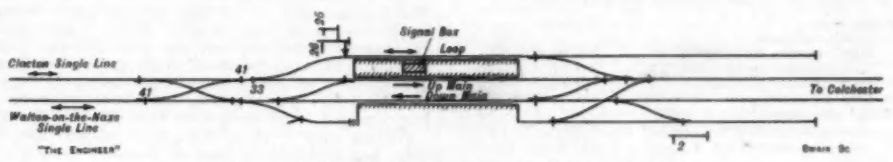
The Clacton Railway Accident.

SPEAKING at the Institute of Transport in May, 1922, Colonel Sir John Pringle, the then Chief Inspecting Officer of Railways, reviewed the causes of some two hundred of the more serious railway accidents of the preceding ten years and showed that only about 6 per cent. occurred on single lines of railway. As practically 20 per cent. of the railway system of Great Britain is single tracked, Sir John was of the opinion that it might justly be inferred, therefore, that single lines were operated, under token systems, with a higher degree of security than railways with two or more tracks. This point is seldom realised, though it should be self-evident, since not only does a token system bring a dual check upon the actions of signalmen and engine men, but the wayside signalling is simpler and therefore less liable to be misread by enginemen.

The prominence thus given to the comparatively greater safety of single lines was, no doubt, due to the serious head-on collision of January 26th, 1921, on a single track at Abermule. All the passenger-carrying single lines in this country are so signalled that, as long as the rules for their operation are obeyed, head-on collisions should not occur. That is more particularly true of the large majority that employ the token system mentioned by Sir John Pringle, as therein each train carries a token, the issue of which is controlled by the two signalmen responsible for the section to which the token applies. As each train carries a token and as only one token can be out of the electrically controlled instruments—one in each of the two signal-boxes—there can be only one train in the section at the same time. If, then, as at Abermule, two trains meet head-on, it is obvious that an irregularity has occurred and the token system necessarily comes under suspicion. In that case it was soon proved that the system was quite in order and that it was in the methods of operation that the cause was to be found. What had happened was that when a local train arrived at Abermule from Montgomery the token for that section was given up, but instead of being placed in its instrument it was, a few minutes later, again handed to the engineman, who, failing to notice the error, started towards Newtown and shortly afterwards met in head-on collision an express from Newtown, which was in correct possession of the section, with a token that the Abermule station staff had concurred in releasing.

This case has been revived by the head-on collision of January 16th between a down newspaper train and an up light engine on the Clacton branch of the London and North-Eastern Railway, whereby the driver and fireman of the newspaper train were killed. The circumstances were inquired into, on behalf of the Ministry of Transport, by Lieut.-Colonel Anderson on January 22nd, and the accompanying sketch of Thorpe-le-Soken Station will assist in an understanding of what happened.

A newspaper train, which does not, however, carry passengers, makes a trip from Thorpe-le-Soken to Clacton; a fresh engine is attached there and the train returns to Thorpe, is reversed and proceeds to Walton-on-the-Naze. On the morning of January 16th the newspaper train arrived back at Thorpe at 6.2 and ran into the loop line. The token for the Clacton section was collected from the driver and one for the section towards Walton handed to him. The engine then came out on to the up main line at the Colchester end of the station, reversed and set back along the up line to beyond No. 37 points, which were then pulled over and the engine set back on to its train, which would be ready to leave when Nos. 41.41 points were opened and signal No. 26 lowered. These movements could not, however, be made, as No. 2 down home signal was "off" for a goods train to enter the station. Meanwhile, as soon as the train-out-of-section block signal had been sent by Thorpe to Clacton, intimating that the newspaper train had arrived, the latter man offered a light engine, for which the man at Thorpe gave permission for a token to be withdrawn and the light engine left Clacton at 6.6. The signalman at Thorpe, at about 6.9, had been watching the down goods train and, when he turned round,



LAYOUT OF TRACK AT THORPE-LE-SOKEN STATION

saw the newspaper train leaving again, despite the signals being at "danger." As the road was set for the Clacton direction the train went that way. For half a mile the Walton and Clacton lines parallel each other, but at that point the latter line turns sharply to the right and falls severely. Why the enginemen failed to notice this, and that the signals were against them, will never be known, as, two miles further on, this train came into collision with the light engine and they were killed. Their guard and the driver and fireman of the light engine were injured and have not yet given their evidence before Colonel Anderson.

LAUNCHES AND TRIAL TRIPS.

PAN NORWAY, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of Aktieselskabet Arnstein, Norway; dimensions, 483ft. 65½ft., by 36¾ft.; to carry oil in bulk. Engines, oil, Wallsend-Sulzer type; constructed by Wallsend Slipway and Engineering Company, Ltd.; trial trip, January 12th.

GERMANIC, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of Sir W. H. Cockerline, of Hull; dimensions, 435ft. by 57ft. 6in.; to carry oil in bulk. Oil engines of Barclay-Curle-Doxford type; constructed by Barclay, Curle, Ltd.; trial trip, January 16th.

TJINEGARA; built by the Netherland Shipbuilding Company, Ltd., to the order of the Java-China-Japan Line, Ltd.; dimensions, 458ft. 4in. by 62ft. by 38ft. 6in.; to carry passengers and cargo. Oil engines; constructed by Werkspoor; trial trip, January 17th.

WARWICK CASTLE, twin-screw motor vessel; built by Harland and Wolff, Ltd.; to the order of Union Castle Mail Steamship Company, Ltd.; dimensions, 650ft. by 75ft. by 44ft. 6in.; to carry passengers and cargo. Engines, oil, Harland-B. & W. type; constructed by the builders; handed over to owners January 17th.

CORDELIA, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of C. W. Bowring and Co., Ltd.; dimensions, 460ft. by 59ft. by 34ft. 1in.; to carry oil in bulk. Oil engine, Burmeister and Wain-Harland and Wolff ype; constructed by J. G. Kincaid and Co., Ltd., Greenock; trial trip, recently.

TWIN-SCREW motor tug; built by James Pollock, Sons and Co., Ltd.; dimensions, 60ft. by 17ft. by 9ft. Oil engines, 120 B.H.P. reversing gear Bolinder type; constructed by the builders; just completed.

CONCEPCION, twin-screw motor vessel; built by A. and J. Inglis, Ltd., to the order of the Argentine Navigation Company, of London and Buenos Aires; dimensions, 200ft. by 37ft. by 8ft. 6in.; to carry passengers and cargo. Oil engines of Harland-B. and W. type; constructed by Harland and Wolff; trial trip, January 19th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

No Change.

THE position in industry and in the iron and steel market in the Midlands and Staffordshire is much as a week ago. Orders during the past seven days have been few and of small content, and nothing has occurred to add materially to works' order books. The outlook remains obscure, consequently purchases are strictly limited to current consumptive requirements. Some interesting gatherings of engineers have taken place in this area, comments upon some of which appear below.

Raw Iron.

The raw iron market has been very inactive during the past fortnight, buying having been of a most meagre character. No doubt this quietude is due in part to the hope of lower selling prices as a result of the meeting of the Central Pig Iron Producers' Association due to take place to-day. Minimum selling rates were fixed to the end of January, and an announcement as to future terms is now due. Specifications for Derbyshire and Northamptonshire pig have fallen away since the drop in Cleveland iron a week or two ago, and a number of local consumers believe that Midland makes will fall in sympathy. It is not anticipated, however, that the reduction, if any, will be more than half a crown per ton. It would perhaps be well to reiterate that Midland smelters assert that previous reductions have been ineffective in bringing new business, and this is bound to weigh heavily in reviewing the present position and the future possibilities. Some of the contracts for continental pig iron which were made at the end of last year are now running out, and so far as can be gathered they are not being renewed. It is hoped that business will now be given to district furnaces, and it is anticipated that some orders will be given out as soon as the position is made clear as regards prices. At the time of writing, the Association's decision had not been made known.

Steel.

In the steel trade business drags. The price reductions have not been followed by any great rush of business, and most of the mills are only getting specifications for small quantities of heavy material. Careful inquiries fail to reveal any considerable amount of business having been placed for heavy steel on the revised terms. Work is slack at the engineering yards and market operations are not marked by less caution than before the associated steel makers announced their new selling terms. The smallness of recent demand for boiler plates has placed makers in such a position that in an endeavour to stimulate buying they have reduced prices by half a crown per ton. They were freely offered on the Birmingham market to-day at £9 5s. per ton. There were steel masters, however, who were not prepared to do business at this figure. Chequer plates have been reduced 5s. per ton to £10 7s. 6d. District re-rollers are short of work. Their price for small bars is about £7 7s. 6d., but they would probably shade this for an attractive bargain. Billets continue to be named £5 12s. 6d. Business is slight in character. Demand for continental steel is almost stagnant. Prices are low enough to attract business, 2in. billets being offered at about £4 10s. delivered, and small steel bars at £5 5s. But with consumers it is not so much a question of price as of consumptive requirements, and they hesitate to buy forward under present conditions.

Finished Iron.

Makers of finished iron in Staffordshire report that business continues poor, there having been no improvement in demand since the year set in. Some of the producers of marked bars are doing a quiet, but steady trade, but short time is the rule at most of the iron mills in this area. The orders for railway material expected at the beginning of the year have not yet come to hand. Prices are unchanged at £12 10s. for marked bars, £10 for Crown iron, £9 for nut and bolt and fencing bars, and £10 17s. 6d. upwards for wrought iron tube strip. The tube trade in this area is meeting with a growing demand, and prospects are decidedly brighter than they were. This is bound to have its effect upon purchases of strip in the near future, and ironmasters in this branch are increasingly optimistic. Belgian No. 3 iron for the bolt and nut industry continues to be offered at low rates, but merchants have considerable difficulty in finding buyers. Consumptive requirements are small.

Galvanised Sheets.

Business in the galvanised sheet industry has been hardly stimulated at all by the reduction of 5s. per ton in selling rates. It is, of course, early as yet to judge the effect of the change in prices, as it was chiefly an inducement to overseas buyers to place orders, the home demand being considered fairly satisfactory for the season. Makers are hoping for some really large orders to repay them for their enterprise. The basis of £11 for 24-gauge sheets, it is stated, now applies in all markets, so that presumably the special arrangement made some months ago in connection with sales to the Indian market have now been withdrawn.

Structural Engineers' Dinner.

At the Midland Hotel, Birmingham, on Saturday night, the fifth annual dinner and ladies' night of the Midland Counties Branch of the Institution of Structural Engineers was held. The toast list resulted in some interesting speeches, emphasising the growing importance of the functions of structural engineers. Mr. H. C. Whitehead—Chairman of the Birmingham and Midland Association of the Institution of Civil Engineers—in proposing the toast of "The Institution," said that, though young, the Institution was firmly established in its useful and important task of fostering the science and art of structural engineering. As scientific research progressed and newer forms of material and workmanship became available, the scope of their work would assume an ever-increasing importance. Mr. R. H. Harry Stanger—President of the Institution—in replying, said that all the engineering institutions were working together in the new Technical and Economical Advisory Council, for the purpose of trying to bring some unanimity into the methods by which buildings were constructed and supervised by local authorities. Their Institution was closely connected with that movement, from which much good must arise. They were also, he said, in close touch with the Steel Research Committee, which was looking into the properties of and new methods of use of materials. In that way they hoped the industry of building would be very considerably assisted. Part of their activities was the teaching of their craft. By arrangement with the Department of Scientific and Industrial Research, lectures were to be instituted in London whereby they would try to show to those who were actually engaged in the use of the materials, and particularly in the first instance in the use of concrete, what was going on outside. Later on similar courses might easily be given under the supervision of the branches. Mr. V. H. Lawton—the Chairman—in acknowledging the toast of "The Midland Branch," submitted by Mr. J. Stuart Lewis, pointed out that enormous demands were to-day being made upon the structural engineer, and the future would see even greater demands made upon him. As members of an Institution, they must see that they were not lacking in backing up the efforts of the structural engineers by giving their attention to those matters which would be helpful in the future planning, building, and reconstruction of the industrial areas.

Electrical Power Engineers.

The annual dinner and dance of the North-West Midland Section of the Electrical Power Engineers' Association was held in Wolverhampton on Friday last, when there was a large attendance of chief engineers of supply undertakings and of manufacturers' representatives, with their ladies. Mr. S. T. Allen—Central England engineer of the Central Electricity Board—in toasting the Association, said that the day had gone by when electricity, on account of its cost, was only for the rich and not to be universally used. He urged upon those present the necessity of looking at the question of distribution and sales from a much broader view-point, and asked them to endeavour to build up their programmes accordingly. Manufacturers and the public were waiting for great developments, and important obligations rested on the distributing authorities. "Electricity," he said, "should be universally used, and when we got to that stage there would be enormous reductions in the cost." Mr. G. R. J. Parkinson, in responding to a toast, remarked upon the "most marvellous" progress made by the industry during the last few years, and suggested with regard to new entrants to the industry that there should be a qualification of "chartered electrical engineer."

Lowering Electrical Costs.

Methods by which the cost of electricity to the consumer could be appreciably lowered were described to members of the Segrave—Engineering and Scientific—Club at Wolverhampton in an address given by Professor Cramp, D.Sc., M.I.E.E., of Birmingham University. He outlined the system of electric heating in use at Basle, Switzerland. There, he said, there was in general use a system of electric heating whereby heat was stored in elements laid in the flooring of big buildings, such as banks, during the night. In the daytime the current was switched off automatically, and the heat accumulated during the night was given out to warm the building. By that means the power station was kept working on an almost steady load, and the cost to the consumer kept proportionately low. He pointed out also that steam storage was practised in Germany to a considerable extent, and with very economical results.

Chilled Iron Rolls.

Professor F. Bacon, head of the engineering department of the University College of Swansea, in an address to members of the Staffordshire Iron and Steel Institute at Dudley on the 20th, dealt with the heavy financial loss resulting from the frequent breakages of chilled iron rolls used in the hot mills of sheet and tin-plate works. Observing that Staffordshire and South-West Wales were deeply involved in the question, he pleaded for a common effort to reduce this tax upon industry. The sums at stake, he said, were large. An authority on tin-plate manufacture had recently stated that roll breakage cost that industry alone £200,000 a year. In the sheet industry the charge was even heavier. A manager of one of the largest sheet and galvanising works in South Wales told him that he estimated it at 5s. a ton on a possible output of 2,000,000 tons, or £500,000 a year, if all the sheet works in the country were fully employed. Even as things were, roll breakage charges on tin production might amount to as high as 8d. a box, or fall as low as 1d. a box. The service demanded of the finishing rolls in the hot mills of sheet and tin-plate works was severe. Judged by ordinary engineering standards, the wonder was not that such rolls broke, but that they stood up to their task as well as they did, especially in these days of struggle for higher and higher outputs.

Tipton Foundry Dispute.

A settlement has been arrived at in the Tipton foundry dispute, and the men have returned to work. As the result of a conference between a representative of the firm of Thomas L. Hale, Ltd., malleable ironfounders, and a deputation of the moulders employed by the firm, it has been agreed that in future wages shall be calculated on the district rate for forty-seven hours, the same conditions to apply to overtime, with allowances for scrap castings. In addition, it has been arranged for a further interview between a member of the firm and the men's representatives in a fortnight's time, and every ensuing month to consider any suggestion or grievance that might arise. On this understanding, the men resumed work on Thursday, after being out since Saturday.

Reactor and Automatic Control Switches.

It is very probable that in the near future the Coventry City Council will apply to the Electricity Commissioners for sanction to a loan of £3218 for the supply and installation of a 10,000-kVA, three-phase, 33,000-volt, reactor and automatic control switches at the Longford generating station, the appliances being necessary before a connection can safely be made to the "Grid." The equipment, I am given to understand, is required to protect the station from excessive discharges of energy in the event of leakages occurring in the "Grid" system.

Rolling Stock Orders.

The Metropolitan-Cammell Carriage, Wagon and Finance Company, Ltd., Saltley, Birmingham, has received an order for fourteen narrow-gauge all-steel low-sided bogie wagons for the Union of South Africa Railways. This same firm has also received an order from the Crown Agents for the Colonies for one second-class all-steel bogie carriage for the Jamaica Government Railways.

The Late Mr. F. E. Sankey.

Mr. Frederick Ernest Sankey, a member of the Bilston firm of Joseph Sankey and Sons, one of the Guest, Keen and Nettlefolds group, died last week at Wolverhampton in his sixty-fifth year. Since 1884 Mr. Sankey had been associated with the business founded by his father in 1864. He became a director in 1902, when the business was turned into a limited liability company. He was well known and very highly respected in Midland industrial circles.

Death of Captain Bache.

The death has taken place at Kidderminster of Captain J. E. K. Bache, a director of George Salter and Co., Ltd., West Bromwich. Captain Bache was badly wounded in the Great War, the injury bringing on paralysis. He was forty-three years of age.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Underground Cable Extensions.

REFERENCE to important extensions to underground cable facilities appears in the annual report for last year of the Manchester District Postal, Telegraph and Telephone Advisory Committee. During the year many additional cables were provided in the Manchester district to meet circuit requirements. New main cables from Manchester to Liverpool, and from Manchester to Huddersfield, were completed and brought into use during the year. These cables, it is pointed out, contain special screened conductors, for the use of the British Broadcasting Corporation from the new North Regional Broadcasting Station at Moorside Edge to Manchester and Liverpool. New cables from Manchester to Chester and from Manchester to Wigan are nearing completion and are expected to be available for public service early in the present year. Extended use of the Manchester repeater station equipments has, it is stated, been made during the past year for long-distance circuits, and several additional repeater equipments have been provided. Repeater equipments of a special type are about to be installed in the repeater station for use on the special circuits provided for the B.B.C. services.

Oil-handling Facilities.

It is understood that the directors of the Manchester Ship Canal Company are considering the advisability of increasing the oil-handling facilities along the Ship Canal, and although no official announcement has yet been made, it is believed that the intention is to double the present capacity of the Stanlow oil dock, which is situated near Ellesmere Port. The sum of £400,000 is mentioned as the probable cost of construction of the dock itself, and a further £60,000 is necessary for the provision of equipment.

Electricity Supply Extensions.

The Electricity Commissioners have sanctioned a scheme submitted by the Irlam—near Manchester—Urban District Council for the supply of electricity to the urban district, and the Ministry of Health has also sanctioned a loan of £103,000 for carrying it out. The undertaking will be carried through by the Stretford and District Electricity Board, which is sponsoring the loan to the Irlam Urban District Council. A large portion of the scheme, effecting an estimated expenditure of £62,000, has been sanctioned as eligible for grant from the Unemployment Grants Committee. The Electricity Committee of Bury Corporation, owing to the D.C. plant at the Rochdale-road power station having become overloaded, has approved a scheme for a change-over to a supply from the A.C. system. For this purpose it is proposed to borrow £20,000—£10,000 for mains and £10,000 for equipment.

Further Economies at Locomotive Works.

Further staff reductions at the Horwich and Crewe locomotive works of the London, Midland and Scottish Railway Company have been announced this week. During the next few weeks the employees at the Horwich works will be reduced by about 90 men, whilst at Crewe reductions to the extent of about 300 men will be made over the same period.

Non-ferrous Metals.

Tin has been the only relatively bright section of the non-ferrous metals market during the past week, copper, lead and spelter all having lost ground compared

with a week ago. Tin is only a shilling or two dearer on balance, but, coming as it does on top of the previous week's recovery, it is a step in the right direction from the point of view of producers of the metal. The market has undergone its usual ups and downs, an increase of over 400 tons in warehouse stocks in this country having its customary bearish influence. This, however, expended itself, and with a moderate home demand and fairly satisfactory advices from U.S.A., the market effected a recovery to the extent indicated. The previous week's gain in the standard copper market has been more than lost, present values being about 15s. a ton below what they were a week ago. Buying in this section has been the reverse of satisfactory, and the immediate outlook is not regarded too confidently. Stocks of lead are much too heavy relatively to the demand for the metal and continue to depress the market, a fall of roughly 10s. a ton during the past week having brought prices to a level below what they have been at any time during the past twenty years. Spelter users are taking only limited supplies and new price history continues to be made, further contractions having to be reported.

Iron and Steel.

Quiet conditions continue to rule in the iron and steel markets here, and immediate prospects are not regarded too hopefully. Deliveries of foundry iron into consumption are probably no worse than they have been during the past three months, although, on the other hand, they are certainly no better, the slackness in textile engineering works accounting for much of the falling off compared with former periods of normal activity. So far as new bookings are concerned, users, for the time being, are persisting in holding off as much as possible and only comparatively small orders are the general rule. For delivery equal to Manchester, Derbyshire and Staffordshire brands are quoted at 69s. 6d. per ton, Northamptonshire at 68s., Cleveland at about 71s., Scottish at from 90s. to 91s., and West Coast hematite at from 84s. to 84s. 6d. Lancashire bar iron meets with a quiet demand, but prices keep up at £10 5s. per ton for Crown quality and £8 15s. for No. 2. Signs of expansion are also conspicuously absent in the steel market. Constructional engineers are mostly poorly engaged and, apart from one or two fairly important schemes for which they are competing, the volume of work in prospect at the present time is not promising. Locomotive builders, also, are taking only limited quantities of material. Prices of British steel are much the same as they were a week ago, but reductions of a shilling or two have occurred in most sections of the market for continental products.

BARROW-IN-FURNESS.

Hematites.

The position in the hematite pig iron trade of North Lancashire and Cumberland is improved, and there is a fuller run of business all round. Local steel makers are now taking good deliveries of iron and are likely to continue to do so. On continental account, however, trade is quiet. Shipments are being made most weeks. The American trade is in the background at present. There are eight furnaces in operation in the whole area, which is very much below normal and large stocks of iron are held. Iron ore is in fairly good demand locally, and best sorts are being sold to Scotland and the East Coast. Importations of Spanish ore are quiet.

Steel.

There is now more activity in the steel trade than for months past. At both Barrow and Workington the plant is engaged and orders are in hand for rails for home use and South Africa, &c. The Barrow hoop mills are also busy. New business in steel rails is still quiet, both on home and overseas account. Hoops are in steady demand and there is a fair call for castings.

Fuel.

The demand for fuel is better, both for coal and coke.

SHEFFIELD.

(From our own Correspondent.)

The Steel Trade Situation.

WHEN the old year closed, few people entertained any hopes of improved trade in the immediate future, and that was as well, for any such hopes would have, by this time, been proved baseless. So far from the general trade position showing any increase in strength, it has rather developed further weakness, and the volume of work on hand, and orders on the books, are alike appreciably less than was the case at this time last year. Partial unemployment has been growing more rapidly than total, and thousands of workpeople who were suspended for the Christmas stoppage are still on the registers of the Employment Exchange. There has been little change in the volume of open-hearth steel production during the last three or four months, and that department is still characterised by scarcity of bulk business and disappointing inquiries. There is a good deal of confidence that business will increase as the year advances, but the present quarter is not expected to show much improvement.

The Special Departments.

The automobile trade continues to send in fairly large orders for supplies in respect of the construction of commercial vehicles, but the demand for touring car requisites is below standard. Acid-resisting, heat-resisting, and ordinary stainless steels are being produced in large volume. The outlook for tool and alloy steels continues fairly good. There is, however, a shortage of work on overseas account, which makes a very material difference to the general position, as, normally, the city's export trade is very considerable in spite of handicaps. Buyers abroad are short of money, and are allowing their stocks to fall to very low levels.

Raw Materials.

Prices of iron and steel materials have undergone no further change since the reductions which came into operation two months ago. The pig iron market is quiet, transactions being of a hand-to-mouth character. Consumption at the foundries remains at a rather low level. Since the beginning of the year there has been a reaction in the scrap market, owing to the absence of forward buying and prices are easier. In ferro-alloys, the position is dull and unchanged.

Railway Work for China.

The departments producing railway axles, tires, and springs, are still very short of work, and the policy of economy which the home railway companies are pursuing does not encourage hopes of improvement from that quarter, while few orders are coming from abroad. There is, however, a bright spot in the situation, which has been brought about by the decision of the Government with regard to the allocation of the Boxer indemnity. This arrangement provides that a sum of three and a-half millions shall be spent in this country during the next two or three years on equipment for the railways of China, which have been starved for some years. No orders of any weight have come to England from that source since 1922, though Belgium has fared much better. The bulk of the present allocation will be spent on rails, locomotives and rolling stock, and it is considered certain that Sheffield will get a considerable amount of work in the manufacture of axles, tires, springs and steel parts of engines. Inquiries are out at present with regard to railway supplies for India. The South Indian Railway is wanting steel tires for locomotive engines, tenders, carriages and wagons, while the Bengal and North-Western Railway is in the market for 416 pairs of wheels and axles.

The South African Railways.

Sheffield is interested in the great orders for material which the South African Railways Administration is announced to have placed in this country, but, although some of the firms associated with the city are sharing in these orders, it does not appear that the work will be done in Sheffield. The United Steel Companies, for instance, gained the order for the steel sleepers, of which no less than 250,000 have been ordered, and the same concern is to supply 3000 tons of rails towards the total of 31,565 tons required; but the orders have been given to the Workington branch of the combine. There appears to be little prospect of a reopening of the Leeds Forge. The Forge was closed as a temporary measure last September, and some of the officials were transferred to other branches of the combine. Steel presses are now being removed to the headquarters of the company at Birmingham, and the activity in this matter last week led to a rumour that the Forge was about to reopen, and 200 men presented themselves for work, only to find that the rumour was denied.

Cold-worked Steel Research.

An interesting report on the first year's working of the Department of the Cold-working of Steel and other Ferrous Metals at the University of Sheffield, has been presented. It states that the topics selected for study included the drawing of wire of about 0·65 per cent. carbon, the rolling of dead mild steel of the class used for deep drawing, and the drawing of mild steel rods of about 1in. in diameter. Special attention has been given to the resistance to fatigue of steel drawn under different conditions, and to the variation of hardness in drawing. Instruments have been devised and constructed for measuring the actual pressure during drawing and rolling, and work is in hand to determine the amount of energy stored in the metal during processes of cold-working. An extensive programme of research is in hand.

A New Pulveriser.

A machine for use as a granulator for producing chippings from gravel, granite, whinstone and other hard materials has recently been developed by Edgar Allen and Co., Ltd., of Tinsley, Sheffield. It is called the K.B. pulveriser, and the firm's magazine states that it produces a product more cubical in form than that produced by any other machine. A feature of this cubical product is that it contains only a low percentage of dust. The pulveriser is an all-steel machine, of very rigid construction, and simple design, the wearing parts being made of Imperial manganese steel. It combines a large output with a low power consumption, and perhaps its most important feature is low cost of maintenance. The design is such that the wear is concentrated on only a few parts, which are very accessible and easily renewable.

A New Chairman.

There has been a change in the chairmanship of Davy Bros., Ltd., the well-known Sheffield engineering firm. Sir William Ellis has resigned his position as chairman and director, in order to devote himself more fully to his very responsible duties in connection with the business of John Brown and Co., Ltd. At the invitation of the directors, Mr. E. J. Fox, the managing director of the Stanton Ironworks Company, Ltd., has joined the board, and he has been elected chairman.

Municipal Electricity.

The Electricity Committee of Derby Corporation has adopted capital expenditure estimates, for the next financial year, amounting to £79,300. This total includes £40,000 for mains and services, £10,000 for transformers, £10,000 for meters, and £10,000 for wiring 1000 houses at £10 each. At Hull, the profit on the electricity undertaking for the financial year ending March 31st, is estimated at £39,000. By six votes to five, the Electricity Committee has decided to recommend that a sum of about £8000—being the equivalent of ¼ per cent. of the outstanding capital of the undertaking—be voted to the relief of the city's rates.

Railway Extensions.

Under a parliamentary bill which has just been deposited by the London and North-Eastern Railway Company, it is proposed to carry out extensions and widenings, a great part of which will be in Yorkshire. A new railway, nearly a mile long, is to be constructed at Northallerton, to form a junction line between the York and Newcastle Railway and the Leeds Northern Railway at Boroughbridge Gates junction. There are to be nearly 5 miles of widening in the North Riding, in the neighbourhood of Pilmoor Junction.

Cutlery and Plate.

There is little change to report in the condition of the cutlery and plate trades, which are finding business done through ordinary shopkeeping channels slack, and are also poorly employed on export account, but which have a good deal of work on hand for restaurant contracts, and for the supply of goods to be sold at the cheap bazaars or given away in return for coupons. Mr. Stanley G. Irving, Commercial Secretary to the British Embassy at Rio de Janeiro, who is visiting Sheffield this week, states that Brazil has an enormous amount of business awaiting the enterprising traveller. One trade in which there is room for great development is that of cutlery, British exports of which to Brazil in 1929 amounted to only £8736, which was a heavy decline compared with the £28,273 of 1925. Mr. Irving makes a suggestion similar to one of those put forward by Mr. A. K. Wilson as a result of his recent visit to South America at the head of a Sheffield Trade Mission—that British industry should be represented in countries such as Brazil by group-selling organisations, subscribed to by a number of manufacturers or traders, which would reduce overhead expenses and would enable the ground to be more adequately covered. The Sheffield Corporation is putting into operation the Celluloid and Cinematograph Act of 1922, so far as it relates to the storage of celluloid. The regulations will affect seven or eight local firms which cut up celluloid handles for cutlery, and probably also some of the larger cutlery makers. The carrying out of the Act to the very letter would involve considerable structural alterations by several of the former.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Outlook.

THERE is no doubt that the position in the heavy iron and steel industries in the North of England is improving gradually, and the outlook is more encouraging than it has been for some months past. The Cleveland market certainly presents a little more life, although it is contended by some that this is due chiefly to the fact that many consumers have arrived at the stage when they must buy something. A little time ago they had no wish to buy anything—they had, in fact, no need to. Now they have been quick to seize the essential fact that the big South African steel orders which have been placed with Tees-side firms will not only provide welcome employment for the steel furnaces and mills, but also absorb a substantial tonnage of pig iron. Thus, with the increasing demand from other directions, there is a definite prospect of a reduction of stocks of iron, which must precede any expansion of output. The shipbuilding and engineering trades, however, are still experiencing a very lean time. Not a single order has been placed with North-East Coast builders so far this year, and as the work already on the stocks is being rapidly completed, the outlook for the shipbuilding industry at the moment is none too promising.

Cleveland Iron Trade.

Whilst export sales of Cleveland pig iron are still very difficult to negotiate, there has been a much improved demand from home consumers, who are now purchasing with a little more confidence. Moreover, the consumption of iron at the steel works has increased, and supply is barely equal to current needs. There are, however, fairly large stocks to liquidate before the question of an increase in the output arises. Meanwhile prices are steady, the fixed minima applying to all areas except Scotland. No. 1 Cleveland foundry iron is 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

Steady sales of East Coast hematite pig iron to home consumers are reported, and in this section a few export transactions have been arranged. Prices are variable, 70s. per ton, which is the nominal quotation for East Coast mixed numbers, being subject to a discount for larger orders.

Iron-making Materials.

There is little or no market for foreign ore, and 16s. per ton is purely a nominal figure for best Rubio ore, whilst the demand for blast-furnace coke falls so far short of the supply that sellers are prepared to shade 17s. per ton as a delivered price to North-East Coast works.

Manufactured Iron and Steel.

A further impetus has been given to the steel industry by the placing of an order by the London County Council with Dorman, Long and Co., Ltd., Middlesbrough, for the supply of several thousand tons of tramway rails and fish-plates. The contract price is £50,926. A lower tender was received from a Belgian firm, but the difference was so small that the London County Council gave the contract to the Tees-side manufacturers. Dorman, Long's have also received a number of small orders for rails, which will ensure greater activity at their steel plant than for some time past. This section of the staple industry has become much more active. Many orders have come along since the decision to increase rebates on plates, sections, and joists to customers using British material only, and

producers of all kinds of railway requisites are better off for work. Following reductions in the price of finished steel and iron bars, the sheet makers have also reduced their prices. In doing so, however, the minimum prices have been made applicable to all areas, the preference to India being abolished. Black sheets, 24 gauge, are now £8 10s., and galvanised corrugated sheets, 24 gauge, £11.

The Coal Trade.

The forward position in the Northern coal trade is causing some anxiety. It is probable that before long collieries will be so much in want of trade that they will be producing well under their respective quotas, and then minimum prices may once more come under review. Merchants are not speculating for forward delivery, and when they get inquiries for early shipment they are compelled to quote on the basis of the minimum, and the offers, it is said, are mostly turned down by customers abroad as being too high. Despite the marketing schemes, which were designed to bring about co-ordination in the coalfields in this country, there is competition at home as well as abroad, as some districts—Yorkshire, for example—have not yet fixed their prices. Northumberland has some minimum prices, but not for all classes of coal, whereas Durham, on the other hand, has no fewer than fifty-three fixed prices. Durham, therefore, is apt to be undercut by districts which have not yet adopted a full minimum price list. Most qualities of Northumberland steam coals are offered freely for next month, and there are second-hand holders willing to discount the minimum prices by about 1½d. for best sorts. Steam smalls are a very weak section, the quiet industrial situation and the severe competition of the cheaper priced Yorkshire coal seriously limiting trade in this area, with the result that unsold stocks are growing. In a generally inactive market best Durham gas coal is about the only feature showing any steadiness. This fuel is finding a satisfactory outlet, mainly to home consumers, and shipments on this account tend to be maintained over the next few weeks. Sellers hold steadily to 15s. to 15s. 3d. Secondary gas coals are abundant at 13s.6d. to 13s. 9d., but only in special circumstances will buyers pay the top prices asked. With the resumption of work in the Welsh coal centres the demand for bunkers has dropped to the ordinary normal requirements. Sellers are now offering all descriptions freely. Best can be obtained at 15s. to 15s. 6d., and good ordinary Durham unscreened at 13s. 6d. All qualities of screened coals are offered freely for next month, but the demand is of limited volume. Prices for spot shipment hold to late full values, but later deliveries are obtainable at 13s. 6d. Durham coking unscreened coals are weak, and supplies are much in excess of requirements, good ordinary being offered at 13s. 6d. Gas coke is in moderate request. Best qualities hold firmly at 21s. 6d., but at this price, despite the limited stocks available, buyers hesitate to commit themselves, and business matures slowly. Patent oven coke is offered readily at 17s., but buyers hold off. Beehive and special grade foundry coke is quoted unchanged at 24s. to 28s. 6d.

SCOTLAND.

(From our own Correspondent.)

Dull Outlook.

It has been stated that here and there business has been moving a shade more freely, and that there are signs of a more hopeful nature. It is admitted, however, that such orders as have been placed are of comparatively small tonnage, and that bookings generally in steel, iron and associated industries, are still considerably below the standard required to establish even a moderate scale of steady employment. Steel producers have given further proof of their desire to assist those buying exclusively from them, and some benefit may soon accrue from the latest adjustments of prices and rebates. It is said, however, that there is still a number of firms outside the scheme. The outlook is not improved by the restriction of the output of coal, caused by the working of the quota system under the Coal Mines Act, and resulting in a scarcity of large coal and a maintenance of a high level of prices altogether detrimental to the expansion of the export trade. Further, the political situation is bound to react and there is not likely to be much forward movement in trade until the situation in this respect is more secure.

Steel and Iron.

So far as steel makers are concerned, the response of buyers to the latest price arrangements has been unsatisfactory, and for most descriptions of material fresh specifications are urgently needed. Sheet makers are rather better employed, and they are more hopeful with regard to Eastern demands, and orders from Canada. Some makers are now working full time. Steel tubes are very short of specifications. Bar iron is without improvement and re-rolled steel bars are not receiving much attention despite a reduction in prices to £6 17s. 6d. home and £6 10s. per ton export.

Pig Iron.

Producers of pig iron still suffer from considerable importations from India, and latest price adjustments have proved of little benefit so far. The number of furnaces in blast has been increased to ten, just double the number in blast two weeks ago. Three furnaces producing hematite have been relit to provide material for an associated company of steel makers, and the other two furnaces have been put into action to replenish depleted stocks. Shipments of pig iron from Glasgow last week amounted to 274 tons (255 tons overseas) compared with 1930 tons (1540 tons overseas) in the same week last year.

Work for Renfrew.

Babcock and Wilcox, Ltd., Renfrew, have received the order for the boiler plant for the Barking power station in connection with the Electricity Board's "Grid" scheme. The value of the contract is nearly £700,000, and is probably the largest boiler plant order ever placed at one time in this country.

Coal.

The scarcity of large coal and high prices for shipment is a feature of the Scottish coal market. Overseas demands are certainly mostly confined to small prompt orders, but more might be done in screened fuel if supplies were available. Collieries are assured of a steady outlet for output and prices are maintained at a level which puts forward business out of the count altogether. Washed nuts are a shade more plentiful, and slightly easier in price. Aggregate shipments amounted to 224,938 tons against 205,897 tons in the preceding week, and 279,801 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

It can scarcely be said that trading conditions are quite back to normal, though considerable progress has been made and matters are settling down. Coal-loading operations last week displayed expansion, as each day showed that an increasing number of tips were working, but still the total quantities of coal shipped at the leading ports were, according to the returns of the Great Western Railway, substantially below those of the corresponding period of last year. The quantity of coal shipped as cargo and bunkers came to 302,900 tons, which compared with 657,706 tons for the same week of 1930. This marked difference was not due so much to a lack of tonnage or loading facilities as to a shortage of coals. Outputs last week were somewhat slow to improve, but, at the same time, there were only 24 idle tipping appliances at the various docks on Saturday last, while on Monday of this week this number was reduced to 23. The chartering of tonnage has been quite active, due to orders being held in abeyance during the stoppage at the pits, while a certain number of orders have come along since. It is, however, questionable whether this level of activity is likely to be maintained. The indications are rather against it, though hopes are entertained that there will be an improvement in the general demand from abroad. At the moment it looks as if it is slackening off. As regards contract operations, there is not a great deal being done, though it is reported that the Madrid, Zarragossa and Alicante Railway of Spain has bought about 30,000 tons of steam coals for delivery during the first quarter of this year, and that the Norte Railway of Spain is shortly inviting tenders for its requirements. News has also come to hand that the Brazilian Central Railways are coming into the market shortly, but what the quantity of coals will be is not yet known. It may be 100,000 tons or 200,000 tons. The last time they asked for tenders the business was secured by a German firm. The French Marine also requires prices, and the Danish State Railways have bought two or three cargoes of Welsh steam coals for delivery next month.

Coalfield Affairs.

On the whole, matters are settling down in the coalfield without a great deal of friction, though, when the members of the Executive Council of the South Wales Miners' Federation met at Cardiff at the end of last week, consideration was given to what were described as irritating actions on the part of some colliery managements, and the decision was come to that all steps should be adopted to look after the interests of the workmen. Those workmen engaged at the Taff-Merthyr Colliery, which was one of the very few undertakings to maintain work throughout the coalfield stoppage, were rewarded when they came to get their pay last week-end by a bonus of £1 per man and 10s. per boy. The miners at this colliery are outside the South Wales Miners' Federation. As regards the new coalfield agreement, the joint sub-committee of owners and workmen's representatives met at Cardiff on Monday, when, from all accounts, the proceedings were of a very harmonious character and material progress was made in coming to agreement on certain points. It was settled that the agreement should operate for three years, subject to an annual review, provided legislative measures did not interfere with the normal course of events. Other subjects such as the position of the surface worker presented more difficulty, but it was generally understood that points in dispute would go to the independent chairman, whose decisions would be accepted by both sides.

Steelworkers' and Tin-platers' Wages.

The ascertainment which governs the wages sliding scale operating in West Wales steel works shows that the average price of Siemens steel bars, f.o.t. makers' works, for the three months ending December 31st last, was £5 5s. 6·753d., equivalent to 2¼ per cent. under the sliding scale agreement. This percentage is a reduction of 6¼ per cent. on the ascertainment for the previous quarter and governs the wages for the three months ending February 1st. The question of certain *ex-gratia* bonuses now operating in the case of the lower paid workmen will be a matter for negotiation between the representatives of the employers and the workmen. In the case of the ascertainment for the quarter ended December 31st last, as it affects the tin-plate workers, there is a slight reduction compared with the previous quarter. The new percentage, which operates from February to May, is 7·875 per cent., as against 8 per cent. for the previous quarter.

Dry Docks and Rationalisation.

The official announcement is made that negotiations have been resumed for the amalgamation of two of the largest dry dock and engineering undertakings in South Wales. They are the Mountstuart Dry Docks, Ltd., and the Cardiff Channel Dry Docks and Pontoon Company, Ltd. This development is not at all surprising, considering the depressed times which have been experienced for so long and the severity of competition, both at home and abroad. Both undertakings have branches at Cardiff, Barry and Newport, and a linking up of the two concerns must inevitably result in the elimination of over-lapping and the effecting of considerable economies. Details of the amalgamation are awaited with considerable interest.

Current Business.

A fair amount of business has been done for early loading, and with a considerable amount of tonnage chartered for prompt positions most collieries are in a comfortable situation for the next week or two. Generally speaking, prices of large and small coals are on the minimum basis, though in a few cases a slight premium can be secured for special grades, such as sized descriptions, which are rather on the scarce side. There is no change in coke and patent fuel, while pitwood is quoted at 23s. to 23s. 6d.

CATALOGUES.

NEGRETTI AND ZAMBRA, 38, Holborn-viaduct, E.C. 1.—"Thermometric Lag."

HARTLEY AND SUGDEN, Ltd., Halifax.—Catalogue of the new "Halifax" multitubular boiler.

EWART CHAINBELT COMPANY, Ltd., Colombo-street, Derby.—A newly issued catalogue on pin chains.

MAVOR AND COULSON, Ltd., 47, Broad-street, Glasgow.—A leaflet on "M. and C." face belt conveyors.

VICKERS-ARMSTRONGS, Ltd., Erith Works, Kent.—"The Vickers Pyramid Hardness Testing Machine."

REXMAN MILL COMPANY, Ltd., 11, Queen Anne's-gate, S.W. 1.—A booklet on "Rexman" balanced rod mills.

THE STAVELEY COAL AND IRON COMPANY, Ltd., Hollingwood, near Chesterfield.—"Sand Spun Cast Iron Pipes."

SMITH AND GRACE, Ltd., Thrapston, Kettering.—"The 'Thrapston' Industrial Endless 'V' Rope Drive."

LIGHT ALLOYS, Ltd., 8t. Leonard's-road, London, N.W. 10.—A booklet on the machining of "Alpax" castings.

HENRY PELS AND CO., Ltd., 32, Osnaburgh-street, N.W. 1.—Catalogue P1931, dealing with heavy presses of all types.

FERRANTI, Ltd., Hollinwood, Lancs.—Folders on three-valve A.C. mains receivers and the screened grid four 1931 model.

BRETTS PATENT LIFTER COMPANY, Ltd., Foleshill Works, Coventry.—A booklet on the firm's petrol-driven industrial truck.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—A brochure on ship wiring and "British Industry Across the Seven Seas."

BUTLER MACHINE TOOL COMPANY, Ltd., Victoria Ironworks, Halifax.—Sheet 1E on all-spiral, all-electric maximum service planers.

GLASS LINED STEEL TANK COMPANY, 19, Southampton-buildings, London, W.C. 2.—General catalogue of "Lion" glass-lined steel tanks.

HADFIELDS, Ltd., East Hecla and Hecla Works, Sheffield.—Particulars of "Era 131" heat-resisting steel for boiler plants operating at high temperatures.

CALENDARS, DIARIES, &c.

BRITISH ROLLING MILLS, Ltd., Tipton, Staffs.—Wall calendar with daily tear-off slips.

CROMPTON PARKINSON, Ltd., Bush House, Aldwych, W.C. 2.—Refills for the company's desk diary stands.

D.P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Wall calendar with monthly tear-off sheets.

EXIDE BATTERIES, Clifton Junction, near Manchester.—Wall calendar with monthly tear-off sheets.

INTERNATIONAL CONSTRUCTION COMPANY, Ltd., 56, Kingsway, W.C. 2.—Wall calendar with monthly tear-off sheets.

LIFTAK ARCHES, Ltd., 38, Victoria-street, S.W. 1.—Wall calendar with monthly tear-off sheets.

L. F. NORRIE AND CO., 30, So. Fort-street, Bonnington, Edinburgh.—Wall calendar with monthly tear-off sheets.

PECKETT AND SONS, Ltd., Bristol.—Wall calendar with monthly tear-off sheets.

PHOTOPRESS, Ltd., Johnson's-court, Fleet-street E.C. 4.—Wall calendar with monthly tear-off sheets.

RANSOME AND MARLES BEARING COMPANY, Ltd., Newark-on-Trent.—Wall calendar.

STANTON IRONWORKS COMPANY, Ltd., near Nottingham.—Pocket diary.

F. WIGGLESWORTH AND CO., Ltd., Shipley, Yorks.—Pocket diary.

CONTRACTS.

COCHRAN AND CO., ANNAN, Ltd., have received an order from Ruths Steam Storage, Ltd., for a Ruths steam accumulator for installation at Westburn Sugar Refineries, Ltd., Greenock. The size of the accumulator is to be 14ft. 9in. diameter by 51ft. long by 7870 cubic feet capacity. It is to be built to withstand a maximum pressure of 160 lb. per square inch, and is to be constructed in five cylindrical strakes with hemispherical ends, and equipped with the usual stand pipes, pedestals, &c.

THE L.N.E.R. reports that the following orders have been placed:—(*a*) With the Clyde Crane and Engineering Company, of Mossend, Lanarkshire, for four 3-ton crank-operated level luffing jib portal cranes for Grimsby, Royal Dock; (*b*) with Fielding and Platt, Ltd., of Gloucester, for one hydraulic coal hoist for 20-ton wagons for Hull, Humber Dock; and (*c*) with John F. Anderson, 33, Sumner-street, Aberdeen, for works in connection with alterations to bedrooms and bathrooms at Palace Hotel, Aberdeen.

W. SISSON AND CO., Ltd., of Gloucester, have received an order from the New Guinea Goldfields, Ltd., for a water-tube boiler installation for the interior of New Guinea. The boilers are for a working pressure of 180 lb. per square inch and each will weigh about 8 tons. As the final transport to the interior has to be carried out by aeroplane, the work has to be designed so that no single part weighs more than 30 cwt. Messrs. Sissons have placed the order for the boilers, casings, and chimney with Abbott and Co., Ltd., of Newark; and for the superheaters with T. Sugden, Ltd., of London.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/- to 19/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 15 0	—
No. 1 Foundry	3 16 0	—
No. 3 Foundry	3 3 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	— *	—
" " Foundry	— *	—
(c) Northampton—		
Foundry No. 3	— *	—
Forge	— *	—
(c) Derbyshire—		
No. 3 Foundry	— *	—
Forge	— *	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (a)	—
	4 5 6 (b)	—
	4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
" " (Land)	10 0 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 0 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
" " (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
" (Small Round)	7 2 6	—
Hoops (Baling)	10 0 0	9 15 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
" (Lancs. Boiler)	9 5 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 12 6 and 9 2 6	—
Intermediate Basic	7 2 6 and 7 12 6	—
Soft Basic	6 5 0	—
Hoops	10 5 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 5 0	—
Billets and Sheet Bars	5 12 6 to 6 10 0	—
Galv. Sheets, f.o.b. L'pool	11 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 5 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/3 to 15/6
Block Tin (cash)	115 0 0
" (three months)	116 10 0
Copper (cash)	44 5 0
" (three months)	44 2 6
Spanish Lead (cash)	13 6 3
" " (three months)	13 5 0
Spelter (cash)	12 7 6
" (three months)	12 12 6
MANCHESTER—	
Copper, Best Selected Ingots	47 0 0
" Electrolytic	48 0 0
" Strong Sheets	75 0 0
" Tubes (Basis Price), lb.	0 0 11½
Brass Tubes (Basis Price), lb.	0 0 10
" Condenser, lb.	0 1 0½
Lead English	14 17 6
" Foreign	13 10 0
Spelter	12 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 5 6	7/-
" " 6 p.c. to 8 p.c.	£22 10 0	7/-
" " 8 p.c. to 10 p.c.	£22 0 0	7/-
" " Specially Refined		
" " Max. 2 p.c. carbon	£32 10 0	10/-
" " " 1 p.c. carbon	£37 5 0	13/-
" " " 0·70 p.c. carbon	£40 0 0	14/-
" " " carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
" " "	£11 5 0 for export	
" Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
" " 75 p.c.	£18 10 0 scale 7/- per unit	
" Vanadium	12/9 per lb.	
" Molybdenum	4/2 per lb.	
" Titanium (carbon free)	9½d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/-
" " Ell	15/6
" " Splint	16/6 to 17/6
" " Trebles	14/6
" " Doubles	13/- to 13/6
" " Singles	12/6 to 13/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	15/- to 15/6
" " Jewel	18/-
" " Trebles	14/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 13/6
Screened Navigation	16/6 to 17/6
Trebles	13/6 to 15/-
Doubles	12/3
Singles	12/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/-
Secondary Steam	14/-
Trebles	13/6 to 14/-
Doubles	12/9
Singles	12/3

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 21/-
NORTHUMBERLAND—	
Best Steams	13/6 to 13/-
Second Steams	12/6
Steam Smalls	10/- to 10/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	15/- to 15/6
Second	13/9 to 14/-
Household	25/- to 37/-
Foundry Coke	26/- to 28/-

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	25/6 to 27/-	—
Derbyshire Best Bright House	20/- to 22/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	18/- to 19/-	—
" " Nuts	15/6 to 16/6	—
Yorkshire Hards	14/- to 15/6	—
Derbyshire Hards	14/- to 15/6	—
Rough Slacks	8/6 to 9/-	—
Nutty Slacks	6/6 to 7/-	—
Smalls	3/- to 5/-	—
Blast-furnace Coke (Inland)	11/- on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.		15/6 to 16/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/6
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/6 to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	14/- to 14/3
Ordinary Smalls	12/- to 13/6
Washed Nuts	18/- to 22/6
No. 3 Rhondda Large	19/9 to 20/3
" " Smalls	15/6 to 16/-
No. 2 " Large	17/- to 17/3
" " Through	15/6 to 16/-
" " Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/6 to 18/-
Patent Fuel	21/6
Pitwood (ex ship)	23/- to 23/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	20/3 to 21/6
Breaker Duff	9/6 to 10/6
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	20/- to 21/6
Seconds	18/- to 20/-
Smalls	12/- to 13/-
Cargo Through	17/- to 18/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham.

(*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers.

(*e*) Delivered Black Country Stations. * Under revision at time of going to press.

French Engineering Notes.

(From our own Correspondent in Paris.)

Trade Protection.

THE outlook for the engineering trades is so far lacking in elements of hopefulness that manufacturers are beginning to call for measures of protection. The fact that there should be a constantly increasing importation of manufactured goods shows that the existing high tariff against them is not sufficient, and it is regarded as a grievance that the commercial arrangement entered into with Germany two years ago should have had the effect of increasing the imports of German goods, while French exports to that country have steadily declined. Makers feel that their situation is becoming critical on account of the increased manufacturing costs, due partly to the higher charges imposed upon them during the past year or two, while costs in some other countries have been coming down, and there are indications that an attempt will be made to adjust the situation by placing further obstacles in the way of imports. There can hardly be any actual increase in the tariff, because there is a moral obligation not to raise it for another year, but there are various legitimate methods for restricting imports in an indirect way. The danger arises more particularly from an alleged importation of goods into France from countries where premiums are paid on exports, and that is stigmatised as dumping, which can be suppressed by actual prohibition. There is, of course, no question of resorting to this expedient, but it is felt necessary to protect French manufacturers, who, except in a few cases, have not attempted to reduce costs by mass production as has been done by some of their foreign competitors.

Wagon Cartel.

Wagon builders are well employed, with the prospect of further large orders being distributed by the home railway companies at an early date. This branch of construction is probably the only one which is not suffering from the crisis that is beginning to affect industrial activity all over the country. Home builders benefit from the international Cartel to the extent that the operations of that body ensure a stability of prices, and the French are anxious to see the Cartel maintained. Elsewhere, the situation is not the same, for builders in Germany, Belgium, Czechoslovakia and other countries depend more largely upon the foreign trade, and as the object of the Cartel is to centralise that business, and distribute it amongst the different countries in agreed quotas, its operations would appear to provide the only means of preventing indiscriminate competition for foreign business that has placed the continental wagon-building industry in an extremely unsatisfactory situation. For some time past German wagon builders have believed that their interests suffer from dependence on the Cartel, because they are financing railway construction in some other countries for the sake of supplying material. In the case of Turkey, a German finacial group has undertaken to supply the Government of that country with money, to be repaid over a considerable period, for the construction of a railway, and German builders will receive orders for 1500 wagons, 30 locomotives, 70,000 tons of rails and other permanent way material and bridgework. They regard this as being independent of ordinary competitive business, and they are said to be disposed to withdraw from the Cartel at the end of the year. That, however, does not meet with the approval of the other countries belonging to the organisation.

Foreign Trade.

Until a little more than a year ago the trading situation of this country was particularly good, with plenty of work at home and an export business that left a favourable balance, but a break set in somewhat suddenly, and since then matters have been going from bad to worse. The trade returns for the past year are therefore instructive as showing the character of the setback. During 1930 the estimated value of imports was 52,344 million francs, a decline on the year of 5876 million francs. The exports totalled 42,829 million francs, or 7309 million francs less than in the previous year. In both cases "material necessary for industry"—that is to say, mainly coal for imports and rolled steel and similar products for exports—constituted by far the greater part of the totals, and while an increase in coal imports helped to swell the tonnage of "material necessary for industry" by 1,413,477 tons, the value fell by 5825 million francs. On the other hand, the imports of manufactured goods amounted to 2,341,601 tons, an increase of 223,162 tons, and the value augmented by 1302 million francs, so that there was a heavy depreciation of values of material necessary for industry, as well as of foodstuffs imported, and a considerable increase in the value of goods purchased. The exports of material necessary for industry amounted to 29,630,828 tons, a decline of 3,402,285 tons, and a diminution in value of no less than 2577 million francs. Manufactured goods totalled 4,805,290 tons, a contraction of 554,812 tons, and the value declined by 4535 million francs. The exports of foodstuffs increased by 629,998 tons, as the result of the dumping of wheat on which premiums were paid, and the value declined by 196 million francs. These figures place the situation in an unfavourable light, for, while the lower world prices favoured imports, considerably more had to be paid for manufactured goods, and there was a particularly heavy decline all round in export values.

Railway Speeds.

With the idea of improving the normal service by accelerating the *rapides* between Paris and Bordeaux, the Paris–Orleans Railway Company is carrying out tests with a train between Tours and Poitiers. It hauls seventeen coaches weighing more than 400 tons. By gaining time between these towns it will be possible to arrange more conveniently the running of ordinary trains. On the first trials an average speed of 68½ miles an hour was attained.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

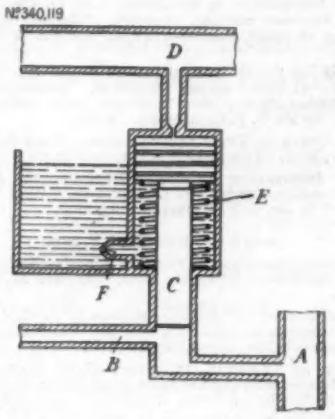
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

340,119. December 11th, 1929.—THE LUBRICATION OF INTERNAL COMBUSTION ENGINES, The Albion Motor Company, Ltd., and J. D. Parkes, South-street, Scotstoun, Glasgow.

The object of this invention is to provide a copious supply of lubricating oil to any appropriate parts of an internal combustion engine at the moment of starting and then to shut off this extra supply to revert to the normal lubricating arrangements. The extra supply of oil is provided by the pipe A and goes to

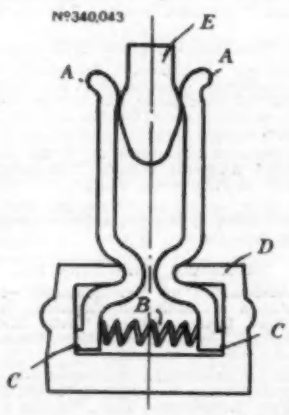


the bearings by the pipe B. The inlet to this pipe—B—is controlled by the plunger C. A piston on this plunger is in communication with the general oiling system by means of the pipe D. It is also held in the open position by the helical spring E, and is provided with a dashpot action through the orifice F. When the engine is first started up, a copious flow of oil is provided through the pipe B, but, as the main lubricating pressure builds up, this extra supply is shut off by the depression of the plunger. Climatic changes are accommodated by the viscosity of the oil in the dashpot.—*December 24th*, 1930.

SWITCHGEAR.

340,043. September 25th, 1929.—CONTACT DEVICES FOR ELECTRICAL APPARATUS, Karel Kesl, of Na Slupi No. 13, Prague, Czechoslovakia.

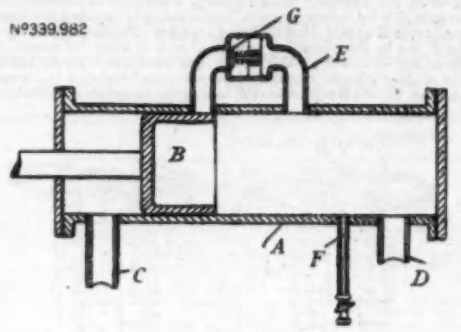
For oil and air switches two contact fingers A are arranged as shown. The ends of the fingers are pressed by a spring B against stops C carried by or formed upon a U-shaped support



D. In moving between the fingers the contact E of the switch compresses the spring B, whereby, the specification states, contact is made in such a manner that the electro-dynamic force produced by the current presses the contact elements against the contact E.—*December 24th*, 1930.

339,982. September 14th, 1929.—ELECTRIC SWITCHES, Sigwart Ruppel, of Palmengartenstrasse 8, Frankfurt a.M., Germany.

This specification describes a switch in which the arc is extinguished by means of gas under pressure, the separation of the contacts being effected pneumatically and the difference in pressure on the two sides of the actuating piston is variable, so as to depend on the position of the piston, with the result that there is, at first, a rapid withdrawal of the movable contact from the fixed contact, followed by a considerably slower movement, and then a relatively rapid movement of the contact. The pneumatic apparatus consists of a cylinder A containing a piston B connected with a piston-rod. A movable contact member, not shown, is attached to the piston-rod. When the switch is to be opened, gas under pressure is supplied through the pipe C, and is supplied through the pipe D when the switch is to be closed. A by-pass pipe E serves to communicate with two points in the cylinder. An outlet pipe F having a stopcock is provided for the purpose of regulating the rate at which gas may leave the cylinder, thus controlling the rate of operation of the switch. On gas under pressure being supplied through the pipe C, the piston is urged towards the right at a high speed, since the right-hand side of the cylinder is opened to the air through the pipe F. When the piston has moved a predetermined distance beyond the left-hand port of the by-pass pipe E, gas under pressure can pass by way of the valve G to the opposite side of the piston. The rate of movement of the piston is at once reduced in accordance with the difference of pressure existing on both sides. As, however, the right-hand side of the cylinder is open to the air through the pipe F, the piston moves slowly forwards until it closes the right-hand port of the pipe E. The difference of pressure on the two sides of the piston then increases again, and the movement of the piston is



accelerated to complete the opening movement of the switch. When the switch is to be closed, the non-return valve G prevents gas under pressure from the pipe D from passing to the opposite side of the piston and thus equalising the pressure on the two sides. The switch is thus closed without reduction in velocity.—*December 15th*, 1930.

ELECTRICAL APPLIANCES.

340,144. January 8th, 1930.—ELECTRIC CONDENSERS, Elektrizitäts-Aktiengesellschaft Hydrawerk, of Windscheidstrasse 18, Berlin-Charlottenburg, Germany.

Combinations of choke coils and condensers are used for various purposes and the condensers are connected in series or parallel with choke coils, or combinations of these two fundamental connections are made, according to requirements. The invention relates to the combination in one structure of elements having inductance and capacity. The drawing, Fig. 1, shows the wound condenser, the thick lines indicating the metal plates and

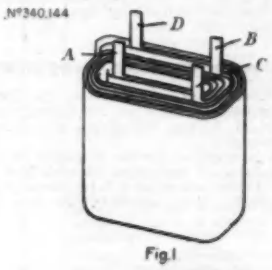


Fig.1

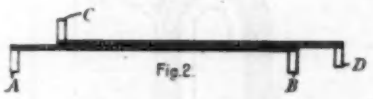


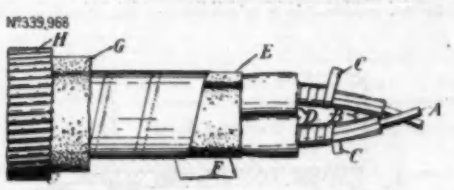
Fig.2.

the thin lines the dielectric material; whilst Fig. 2 shows such a condenser in section in the unwound state. The foil with terminals A B is first wound alone to form a spiral coil with any suitable number of turns. The two foils are then wound together from the point A to B, and from B the second foil is wound alone. Connections are made to each end of each plate, as at A, B, C, and D. Each winding A B and C D forms an inductance coil, the parts of each coil between the points A and B forming a condenser also. The remaining parts A to the point C and B to D do not add substantially to the capacity between the windings.—*December 24th*, 1930.

TELEGRAPHS AND TELEPHONES.

339,968. September 16th, 1929.—ELECTRIC SIGNALLING CABLE, *Electrical Research Products, Inc., 195, Broadway, New York.*

A marine signalling cable constructed in accordance with this invention is claimed to have less attenuation than other cables, and to be less subject to difficulties arising from extraneous electrical and magnetic disturbances. Reflection and magnetic modulation losses are also decreased. The central copper conductors A are surrounded by a number of segments B, say, six, shaped to fit the central conductors. Upon the segments is a helix of loading material C. The conductor is heat treated after the loading material is applied. The loading



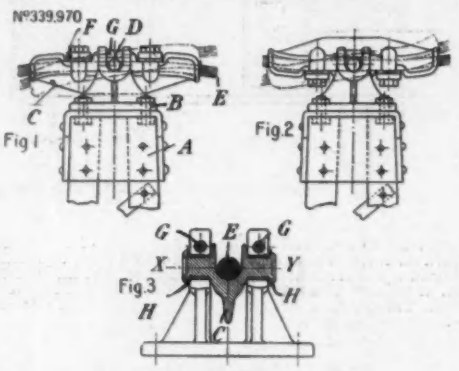
material is surrounded by a pressure equalising fluid, such as liquid bitumen or melted rubber. Surrounding the loading material is a sheath of insulating material D, such as gutta-percha or gutta-percha substitute. The entire structure thus far described constitutes a unit, hereinafter referred to as a core. Two such cores are twinned together in a twinning machine and given a spiral lay or pitch of several feet. In order to give this twinned core the cylindrical shape required for armouring, the interiorally cusped crescent-shaped spaces on both sides thereof are filled by a filler E, such as jute, which is moulded around the twinned cores to produce a spherical cross section. Teredo tape F, jute G, and armour wires H are provided to surround the cores in a suitable manner.—*December 16th*, 1930.

TRANSMISSION OF POWER.

339,970. September 16th, 1929.—EARTH CONDUCTOR SUSPENSIONS, Johannes Wilhelm Hofmann, of Wilhelm Hofmann, of Kötzschenbroda, near Dresden, Saxony.

The usual method of rigidly securing earth conductors to transmission line poles, the inventor points out, gives rise to

undulatory mechanical oscillations, which are produced by the wind, and additional bending stresses occur at the points at which the earth conductors leave the clamping plates, so that the wires are weakened and break. The object of the invention is to overcome this difficulty. At the top of the mast A a carrying bracket B is bolted. The carrier has two U-shaped recesses in which the clamping trough piece C is adapted to rotate about an axis X Y by means of studs D, this axis intercepting the earth conductor E at a level with its centre line. The earth conductor itself lies in the clamping trough C and is fixed by means of clamping covers F. The studs are prevented from falling out of the U-shaped recesses of the carrying bracket B by means of pins G. When the earth conductor undergoes oscillatory

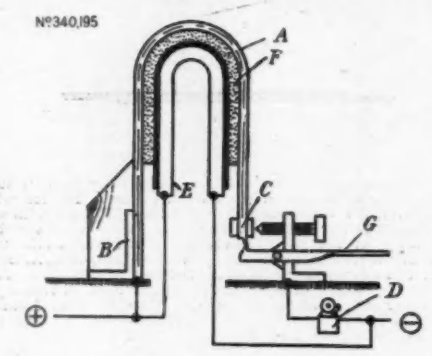


movements in a vertical plane, the clamping trough C can easily follow these movements, and will take up a position as shown in dotted lines. The earth conductor undergoes no additional bending strains at the point of leaving the clamping trough C, the oscillations being transmitted without interruption through the suspension apparatus onwards. At suspension points where the earth conductor on both sides of the clamp is inclined upwards, the clamping trough may be turned upside down or rotated through 180 deg., as shown in Fig. 2. The clamping trough can rotate in the U-shaped recesses of the carrying bracket B, and in order to obtain a good durable bearing, bushes H of wear-resisting metal are fitted over the studs D and are protected from lateral displacement by turning over the edge of the studs.—*December 16th*, 1930.

MEASURING AND TESTING INSTRUMENTS.

340,195. April 22nd, 1930.—APPARATUS FOR INDICATING POLLUTIONS IN THE ATMOSPHERE BY ILLUMINATING AND SIMILAR GASES, F. Freitag, Pohl-Gönz, near Butzbach, in the Hart, Germany.

This instrument is intended for the detection of oxidisable gases in the atmosphere. It comprises a flexible bow A, which is anchored at B. At the other end C it provides an electrical contact for the operation of the alarm D. The bow is perma-

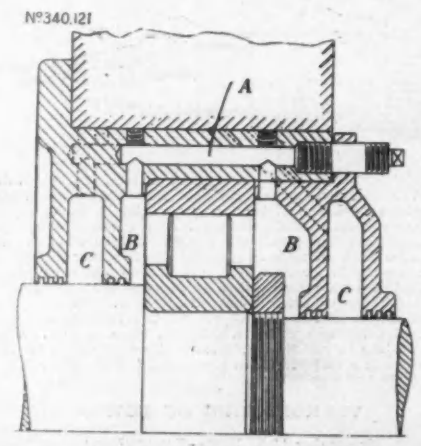


nently heated to a temperature of about 70 deg. Cent. by the electrical heating element E. Between this element and the bow proper there is a layer of platinum asbestos F, which, by catalytic action, raises the temperature of the bow still further in the presence of oxidisable vapours, and closes the alarm circuit. The catch G is provided to keep the circuit closed in the event of the vapours passing in waves until such time as it is attended to by hand.—*December 24th*, 1930.

MISCELLANEOUS.

340,121. December 12th, 1929.—THE LUBRICATION OF BALL AND ROLLER BEARINGS, G. A. Juhlin, Redscar, Moss-lane, Timperley, Chester, and Associated Electrical Industries, Ltd., Bush House, Aldwych, London, W.C. 2.

In this specification it is pointed out that if ball or roller



bearings are supplied with a grease lubricant of high melting point, there is a liability for the grease to be pushed aside from the rolling surfaces and to loose its function. On the other hand, if a readily meltable grease is used, it may be wasted by creeping along the shaft outside the bearing. The inventors consequently lubricate the bearing itself by means of a soft grease introduced through the passage A and the chambers B B, while the chambers C C are packed with a hard grease to prevent the egress of the other.—*December 24th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—At Lyons' Corner House, Angel, Islington, N. 1. Annual dinner and dance.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. 1. Graduates' Section, London. Reception and conversazione. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Modern Methods of Production of Small Machined Work," by Mr. Wilfrid Fish. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—At the Mining Institute, Newcastle-on-Tyne. "The Whaling Factory Ship 'Vikingen,' with some Notes on Whaling," by Mr. C. F. Christensen. 6 p.m.

ROYAL CORPS OF NAVAL CONSTRUCTORS.—Park Lane Hotel, Piccadilly, W. 1. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "First Defence of Gibraltar," by Dr. G. M. Trevelyan. 9 p.m.

MONDAY, FEBRUARY 2ND.

BRADFORD ENGINEERING SOCIETY.—In the Hall, Technical College, Bradford. "Electric Lifts," by Mr. L. J. Gooch. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. Lecture No. II., "Some Modern Developments in Microscopy," by Dr. L. C. Martin. 8 p.m.

SOCIETY OF CHEMICAL INDUSTRY.—Joint meeting of the London Section with the Chemical Engineering Group and the Faraday Society in the Rooms of the Chemical Society, Burlington House, W. 1. Papers will be contributed by Dr. E. B. Maxted on "The Specific Activity of Catalysts;" Dr. E. K. Rideal, F.R.S., on "Specific Catalytic Surfaces." 8 p.m.

SOCIETY OF ENGINEERS.—In the Apartments of the Geological Society, Burlington House, W. 1. Opening meeting and presidential address by Mr. H. W. Towse. Presentations of 1930 premiums. 6 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY.—Victoria Hotel, Wolverhampton. "Electric Cables and Jointing," by Mr. T. A. G. Margary. 7.30 p.m.

TUESDAY, FEBRUARY 3RD.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. Discussion on "Refractories," to be opened by Mr. C. E. Moore and Mr. I. A. Bailey. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Rustless Steels as Applied to Automobiles and Aircraft," by Dr. W. H. Hatfield. 7.45 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE, STUDENTS' SECTION.—In the Birmingham University, Edmund-street. "Porcelain Insulators," by Mr. G. H. Halton. 7 p.m.

WEDNESDAY, FEBRUARY 4TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. The following paper will be read and discussed, "Some Measurements of a Loud Speaker in Vacuo," by Mr. P. K. Turner. 6 p.m.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE.—Houghton-street, Aldwych, W.C. 2. "Muscular Work and Fatigue," by Dr. G. P. Crowden. 6 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Effect of Standardisation on Engineering Progress," by Mr. C. Le Maistre. 8 p.m.

THURSDAY, FEBRUARY 5TH.

BRITISH ASSOCIATION OF REFRIGERATION.—In the Hall of the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W. 1. "Some Instruments for Refrigeration Work," by Dr. Ezer Griffiths, F.R.S. Discussion. 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "Two Transmission Line Problems: Suspension Insulators for Industrial Areas in Great Britain; Conductor Vibration," by Mr. P. J. Ryle. 6 p.m.

FRIDAY, FEBRUARY 6TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Adjourned discussion, "High-pressure Locomotives," by Mr. H. N. Gresley. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Aerial Wire Ropeways," by Mr. J. W. White. Slides. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Mechanics of the Trade Slump," by Mr. J. M. Keynes. 9 p.m.

RAILWAY CLUB.—In the Royal Scottish Corporation Rooms, Fetter-lane, London, E.C. 4. Presidential address. Annual general meeting. 7.30 p.m.

MONDAY, FEBRUARY 9TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Gas Refinement of Metals and Alloys," by Mr. D. R. Tullis. 7.30 p.m.

TUESDAY, FEBRUARY 10TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Stress in Metals," by Mr. A. Wragg. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—At the Y.M.C.A., Swansea. "Application of Copper to the Building Trade," by Mr. Julius Frith. 6.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. Daimler Premium paper, "The Compression-ignition Automobile Engine," by Mr. S. W. Nixon. 7.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C. 2. "Electric Welding in the Construction of Sea-going Vessels," by Mr. Gustav Wahl. 7.30 p.m.

THURSDAY, FEBRUARY 12TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Joint meeting with Electroplaters' and Depositors' Technical Society in the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "Electrolytic Processes in Metallurgy," by Dr. H. J. T. Ellingham. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Connaught Rooms, Great Queen-street, W.C. 2. Annual dinner. 7 p.m. for 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, London S.W. 1. "Welding Practices and Methods Based on My Own Experiences," by the Winner of the Operative Welders Prize Competition, 1930. 7.45 p.m.

FRIDAY, FEBRUARY 13TH.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION.—Hotel Russell, Russell-square, London, W.C. 1. Supper dance. 8 p.m. to 2 a.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-Ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "The Applications of High-nickel, Nickel-copper Alloys and Pure Nickel in Industry," illustrated by a cinematograph film, by Mr. N. C. Marples. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON): MANCHESTER CENTRE.—In the Building of the Manchester Literary and Philosophical Society, 36, George-street, Manchester. "The Development of the Piston Valve to Improve Steam Distribution," by Mr. D. W. Sanford. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Ordinary meeting. Honorary member's lecture, "Monolith Foundations," by Mr. H. Cartwright Reid. 7.30 p.m.

SATURDAY, FEBRUARY 14TH.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—At the Dudley Arms Hotel, Dudley. Annual dinner. 6.30 p.m.

MONDAY, FEBRUARY 16TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-Ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. Conjoint meeting for a discussion on "Refractories for Heating and Melting Furnaces." 7.30 p.m.

MONDAY TO FRIDAY, FEBRUARY 16TH TO 27TH.

BRITISH INDUSTRIES FAIR, 1931.—Castle Bromwich, Birmingham; Olympia and White City, London. Open 9.30 a.m. daily.

TUESDAY, FEBRUARY 17TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Official visit to the British Industries Fair, Birmingham.

WEDNESDAY, FEBRUARY 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Metropole Hotel, Leeds. "Rustless Steels as Applied to Automobiles and Aircraft," by Dr. W. H. Hatfield. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The Engineers' Club, Albert-square, Manchester. "Light Alloy Piston Development," by Mr. E. V. Pannell. 7 p.m.

OVERHEAD LINES ASSOCIATION.—At the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Discussion on "Wayleaves." 5.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Art of the Bridge Builder," by Mr. Gavin Heynes Jack. 8 p.m.

FRIDAY, FEBRUARY 20TH.

INSTITUTE OF METALS.—Official visit to the British Industries Fair at Birmingham. Full particulars may be obtained from Dr. G. Shaw Scott, 36, Victoria-street, London, S.W. 1.

JUNIOR INSTITUTION OF ENGINEERS.—At Royal United Services Institution, Whitehall. Special meeting. "Notes on the Construction of the Variable Density Tunnel for the National Physical Laboratory at Teddington," by Mr. A. J. Grant. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Midland Hotel, Manchester. Annual dinner. 6.45 for 7.15 p.m.

SATURDAY, FEBRUARY 21ST.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—At the Trocadero Restaurant. Annual dinner. Tickets from Mr. F. R. C. Rouse, 15, Clifton-gardens, Golders Green, London, N.W. 11.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. EDWIN DEMPSTER has been appointed the Secretary of the Belfast Association of Engineers, in succession to Mr. Cyril K. Edwards, who recently resigned that office.

THE ASSOCIATED EQUIPMENT COMPANY, Ltd., of Windmill-lane, Southall, Middlesex, ask us to announce that from February 2nd the telephone number of its offices and factory will be changed from Southall 1501 to Southall 2424 (seventeen lines).

SIR PHILIP DAWSON, M. Inst. C.E., M. Inst. E.E., has become a Vice-President of the Empire Development Association, formed to urge, encourage and aid development of the Empire and its industries and resources, including those of the United Kingdom.

MR. HUGH CAMPBELL, M.I. Mech. E., founder and late managing director of the Campbell Gas Engine Company, Ltd., Halifax, asks us to announce that he has become associated with the engineering firm of Clayton, Goodfellow and Co., Ltd., Atlas Iron Works, Blackburn, which is now his new address. Telephone No.: 7186 (2 lines) Blackburn. Telegrams and cables: "Goodfellow, Blackburn."

POWER FARMING.—Work in preparation for spring sowing will be a feature of a demonstration of tractors and power farming equipment to be held at the Harper Adams Agricultural College, Newport, Shropshire, on Tuesday and Wednesday, March 10th and 11th. The operations will include ploughing, cultivating and harrowing, while the capabilities of the horticultural tractor, particularly in connection with the hoeing of row crops, will be shown. It is expected that certain mole-draining outfits will also be present. A representative entry is already in prospect, and further details will be sent by the Engineering Department of the College, to anyone interested.